ABSTRACT BOOK

1ST INTERNATIONAL CONFERENCE ON EXPLORING INNOVATIVE SOLUTIONS FOR ENERGY AND WATER CHALLENGES FOR SUSTAINABILITY
(16-17 April, 2025)

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1st International Conference on Exploring Innovative Solutions for Energy and Water Challenges for Sustainability

16-17 April 2025

"Unlock the Energy & Water Resources: Meeting Marketing Demands"

ABSTRACT BOOK

ORGANIZED BY

**DEPARTMENT OF PETROLEUM & NATURAL GAS ENGINEERING,
MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, SZAB CAMPUS,
KHAIRPUR MIR'S**

IN COLLABORATION WITH

**THE BENAZIR BHUTTO SHAHEED UNIVERSITY OF TECHNOLOGY AND SKILL DEVELOPMENT, KHAIRPUR MIR'S, &
THE SINDH HIGHER EDUCATION COMMISSION**

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ABSTRACT BOOK OF 1ST INTERNATIONAL CONFERENCE ON EXPLORING INNOVATIVE SOLUTIONS FOR ENERGY AND WATER CHALLENGES FOR SUSTAINABILITY

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About the conference

The 1st International Conference on Exploring Innovative Solutions for Energy and Water Challenges for Sustainability (ICEWS 2025), organized by the Department of Petroleum & Natural Gas Engineering, Mehran University of Engineering and Technology, SZAB Campus Khairpur Mir's, in collaboration with the Benazir Bhutto Shaheed University of Technology and Skill Development (BBSUTSD), Khairpur, and the Sindh Higher Education Commission (HEC), Pakistan. With the theme "Unlock the energy and water resources: Meeting market demands" this conference seeks to engage policymakers in shaping effective regulations, showcase advancements in technology, explore creative solutions, and raise public awareness about the pressing issues of energy and water scarcity.

The conference aims to provide an International and national forum to exchange of ideas among interested researchers, eminent scholars, scientists esteemed academicians, developers, faculty, scientists, practitioners, engineers and young engineers from industry, academia and research & development organizations and to address critical challenges facing Pakistan's energy and water resources, fostering the exchange of innovative ideas and solutions to promote sustainable energy practices for socioeconomic growth. In addition, the conference also offers numerous benefits to Pakistan by fostering innovative solutions to its energy and water crisis. As one of the cornerstone sectors of Pakistan's energy landscape, the oil and gas industry is grappling with increasing demands for energy efficiency, reduced environmental impacts, and the integration of renewable energy solutions. A good number of foreign and national professors, industry professionals and researchers will join the conference and share their insights on cutting-edge research studies. In addition, faculty and students of various universities around the world and our country have submitted their abstracts and will present their research work in the conference. This conference not only provides a platform for them to discuss strategies for transforming the sector while ensuring its continued contribution to socioeconomic development but an opportunity to interact with each other and the scholars from various countries and universities. We hope that together, we can shape a sustainable future that prioritizes the socioeconomic benefits of efficient energy and water use.

Acknowledgment

The organizers of the ICEWS 2025 sincerely acknowledge the collaboration and support of Sindh Higher Education Commission (Sindh HEC) and Benazir Bhutto Shaheed University of Technology and Skills Development, Khairpur Mir's. We are also deeply grateful to Oil and Gas Development Company Limited (OGDCL) and Pakistan Petroleum Limited (PPL) for their generous sponsorship.

We highly appreciate the active participation of our esteemed international and national keynote speakers, authors, and participants. Our heartfelt thanks go to the technical committee members for their dedicated efforts in reviewing abstracts.

We would also like to extend our gratitude to the editorial team members for their invaluable contributions to the publication of the abstract book.

At the end, we extend our sincerest gratitude to dedicated committee members, departmental faculty members and student volunteers who worked day and night to make this event a success. Their dedication, enthusiasm, and relentless efforts are highly valued and appreciated.

Thank you all for making ICEWS 2025 a success!

Committees

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15	Prof. Dr. Vishnu Prasad Pandey	Institute of Engineering, Tribhuvan University, Nepal	Member
16	Dr. Mazhar Baloch	A'Sharqiyah University, Oman	Member
17	Dr. Najeebullah Lashari	Dawood UET, Karachi	Member

INTERNATIONAL SPEAKERS

Sr. No. **Biography of international speakers**

01 **Prof. Dr. Rahisham Bin Abd Rahman**

Associate Professor and Deputy Dean at the Center of Graduate Studies, Universiti Tun Hussein Onn Malaysia (UTHM). Ph.D. in High Voltage Engineering and an M.Eng. in Electrical and Electronic Engineering from Cardiff University, UK. With over a decade of experience in academia and industry, his research focuses on dielectric materials, high-voltage insulation systems, grounding, and lightning protection.

02 **Dr. Yusufu Abeid Chande Jande**

Associate Professor of Material Science and Engineering and deputy Center Leader, WISE-Futures center at the Nelson Mandela African Institution of Science and Tanzania. Dr. Jande holds PhD degree in Mechanical Engineering from Ansan, South Korea. His research area is focused on capacitive deionization for desalination and CO2 capture and rapid prototyping specifically in producing uniformly porous and graded porous structures using selective laser sintering (SLS) and producing composite materials from porous structures manufactured using SLS.

03 **Prof. Dr. Vishnu Prasad Pandey**

Professor with the Department of Civil Engineering and Director at the Center for Applied Research and Development (CARD), Institute of Engineering (IOE), Tribhuvan University, Nepal. Dr. Vishnu holds a Ph.D. in Integrated River Basin Management from the University of Yamanashi, Japan. Dr. Vishnu has extensive professional and academic experience, having been involved in various research and professional projects in Nepal and abroad. He has made significant contributions to advancing research and academics in the field of water resources. His expertise includes sustainable water management, climate change impacts on hydrological systems, and innovative solutions for water conservation and flood mitigation, with a focus on hydrology, water resources, and climate change impact assessment and adaptation.

04 **Prof. Dr. Nasir Golsanami**

Professor at the College of Energy and Mining Engineering of Shandong University of Science and Technology, China. He is the winner of the “Talented Young Scientists Program", Director of the "China-Iran Science and Technology Office", "Outstanding Foreign Expert in the Education System of Shandong Province", winner of the "Excellent Presenter Award", Honorary Professor at SCO, winner of the

"Qilu Friendship Award", "Honorary Citizen of Shandong Province", etc. Naser's research work focuses on the interdisciplinary studies of Geomechanics, Rock Mechanics, and Rock Physics of Unconventional Oil and Gas Reservoirs, Natural Gas Hydrate Reservoirs, Deep Coalbed Methane Reservoirs, and Geothermal Reservoirs with Artificial Intelligence, Big Data and Data Mining, Digital Rock Analysis, and 2D Nuclear Magnetic Resonance Technology, etc. He has published more than 60 SCI (ISI) papers in internationally recognized top journals. He has been granted 8 invention patents.

05 Dr. Muhammad Wajid Saleem

Senior Lecturer in the Mechanical and Energy Engineering Department and the Program Lead for the MSc Energy and Sustainable Development program at De Montfort University, UK (Dubai Campus). He earned his Ph.D. in Mechanical Engineering from Hanyang University, South Korea. Dr. Wajid's research focuses on the Water-Energy Nexus, with key interests in salinity gradient energy, solar energy applications, water desalination, and sustainable development. His work contributes to advancing energy-efficient solutions for global water and energy challenges.

National Speakers

Sr. No. **Biography of international speakers**

01 **Prof. Dr. Muhammad Sagir**

Dean of all faculties at Khwaja Fareed University of Engineering and Information Technology (KFUEIT), Rahim Yar Khan, Pakistan, and Director of the Rajanpur Campus, KFUEIT. Dr. Sagir holds PhD in Chemical Engineering from Universiti Teknologi Petronas (UTP), Malaysia. His research expertise includes Enhanced Oil Recovery (EOR), specifically surfactant and polymer flooding, development of advanced materials for energy and wastewater treatment, photo-catalysis, and sustainable energy solutions.

02 **Prof. Dr. Amir Mahmood Soomro**

Professor of Department of Electrical Engineering at Mehran University of Engineering and Technology, Jamshoro, Pakistan. He holds a Ph.D. in Electrical Engineering from the School of Automation, Beijing Institute of Technology, P. R. China. Dr. His research focuses on Power Electronics, Control

engineering and Renewable Energy. In addition to the Electrical Engineering, he has got internationally recognized Health, Safety and Environment (HSE) certifications and qualifications form USA and UK based institutes and boards i.e. OSHA, NEBOSH and IOSH.

03 Dr. Sajid Hussain Siyal

Associate Professor of the Department of Metallurgy and Materials Engineering at Dawood University of Engineering and Technology (DUET), Karachi, Pakistan. He holds a Ph.D. in Materials Science and Engineering from the Advanced Composite Center, State Key Laboratory of Organic-Inorganic Composites, Beijing University of Chemical Technology, China. With over a decade of experience in academia and research, Dr. Siyal has made significant contributions to the field of materials science. His research focuses on energy storage devices, lithium-ion batteries, and nanocomposite materials.

04 **Dr. Yasir Niaz**

Associate Dean of the Faculty of Mechanical and Agricultural Engineering and the Head of the Department of Agricultural Engineering at Khwaja Fareed University of Engineering and Information Technology, Pakistan. He holds a Ph.D. in Environmental Engineering from Dalian University of Technology, Dalian, China. Dr. Yasir expertise lies in Environmental Engineering and Management, with a focus on Air Pollution Monitoring and Control.

05 **Dr. Dur Muhammad Soomro**

Associate Professor of Department of Electrical Engineering at DHA Suffa University Karachi, Pakistan. He is an accomplished electrical engineering professional with over 34 years of experience spanning academia, research, and industry. He has published 26 journal articles, 27 conference papers, 1 book chapter, 2 lab modules, and 1 teaching module. His research focuses on power system stability, renewable energy integration, power quality, and artificial

intelligence applications in electrical engineering.

06 **Syed Tariq Hasany**

Mr. Tariq is a seasoned geoscientist and exploration leader specializing in subsurface technologies, unconventional resources, and digital transformation. He is currently a leader in the Petroleum Engineering Consulting Group, Karachi, Pakistan, with 34 years of global experience in the oil and gas industry. Throughout his extensive career, Mr. Tariq has worked across Pakistan, Malaysia, Argentina, Central Asia, and the Middle East, delivering impactful results in both conventional and unconventional exploration. With a proven track record of managing multi-million-dollar exploration budgets and leading cross-functional teams, he has played a key role in advancing exploration strategies and optimizing hydrocarbon resource development.

07 **Dr. Kashif Hussain Mangi**

A distinguished researcher and educator recognized for his interdisciplinary contributions to renewable energy

systems, CO_2 management, and sustainable water solutions. He currently serves as an Academician specializing in Energy Management, Engineering Management, and Sustainability at the Berlin School of Business and Innovation, Germany. He holds a Ph.D. in Process and Bioprocess Engineering from the University of Nantes, France. His research focuses on Solar Thermal Engineering, Heat and Mass Transfer, and Renewable Energy.

08 **Engr. Tahir Soomro**

Deputy Director and Oil Sector Coordinator at the Ministry of Energy (Petroleum Division), Government of Pakistan. Mr. Tahir is involved in overseeing and managing key aspects of Pakistan's oil sector, ensuring efficient policy implementation, regulatory compliance, and strategic planning. He holds a B.E. in Petroleum & Natural Gas Engineering from MUET SZAB Campus, Khairpur Mir's.

09 **Engr. Muzaffar Ali**

Deputy Chief Engineer (Production) at Pakistan Petroleum Limited, Karachi,

Pakistan. Muzaffar Ali Mahar is a seasoned petroleum engineer with over 12 years of expertise in oil and gas production operations. He holds master's degree in petroleum engineering from the University of Calgary, Canada and specializes in production optimization, well completions, stimulation, testing, and reservoir surveillance. He has led strategic production planning, rig-less well interventions, and technical evaluations for downhole equipment. With certifications such as IWCF Level-4 (Well Interventions) and proficiency in industry-standard software, Muzaffar brings a strong problem-solving mindset, technical acumen, and leadership capabilities to optimize hydrocarbon recovery efficiently.

10 Engr. Muhammad Furqan Qureshi

Senior Engineer at Rutledge Omni Services PTE LTD, Singapore specializing in occupational health, process safety, and environmental sustainability. He holds a master's degree in Petroleum Engineering from MUET, Jamshoro, and is currently pursuing a PhD at the same

nanofluid applications for wettability alteration, hydrogen geo-storage, and circular economy-driven solutions for the oil and gas sector. With expertise in risk mitigation and advanced reservoir engineering, he has played a pivotal role in developing and implementing high-impact safety frameworks for complex drilling and production operations.

11 **Engr. Omer Ahsan**

Senior Petroleum Engineer (Well Operations) at Mari Energies Limited (formerly MPCL). He holds a bachelor's degree in petroleum engineering from NED University of Engineering and Technology and has 10 years of diverse experience in the oil and gas industry. He has served in key roles, including Production Engineer-I and Well Operations Engineer-II, leading major projects such as the Pressure Enhancement Facility (PEF) and field development initiatives. Beyond his technical contributions, he actively mentors' young engineers and shares industry insights to foster innovation and

List of papers

International Keynote speakers

National Keynote speakers

Presenters

ICEWS-Keynote-1

GREEN HYDROGEN: UNLOCKING THE FUTURE OF CLEAN ENERGY

Prof. Dr. Rahisham Bin Abd Rahman[1]
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ABSTRACT:
Green hydrogen is increasingly recognized as a key enabler of the global clean energy transition. Produced through electrolysis powered by renewable energy sources, it offers a sustainable alternative to fossil fuels with applications in power generation, transportation, and industrial processes. Despite its potential, challenges remain in areas such as cost-effectiveness, large-scale production, infrastructure readiness, and policy support. Recent advancements in electrolysis efficiency, hydrogen storage, and distribution technologies are driving its feasibility as a mainstream energy solution. In Southeast Asia, countries including Malaysia are positioning themselves as emerging hubs for green hydrogen development, leveraging abundant solar and hydropower resources. The integration of green hydrogen into national energy strategies has the potential to enhance energy security, reduce carbon emissions, and support long-term sustainability goals. A critical examination of current developments, technological breakthroughs, and policy frameworks provides valuable insights into the role of green hydrogen in shaping the future energy landscape.

KEYWORDS: *Hydrogen, Energy, Power Generation, Carbon Emissions, Sustainability*

ICEWS-Keynote-2

DO WE HAVE THE RIGHT CHOICE OF WATER PURIFICATION TECHNOLOGY?

Dr. Yusufu Abeid Chande Jande[1, 2]

[1]Materials Science and Engineering, The Nelson Mandela African Institution of Science and Technology, P.O.BOX 447, Arusha, Tanzania

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ABSTRACT:

The concept of water purity started to be considered many years ago, before Jesus (Isa bin Mariam) was born. For example, between 14000 and 8000 BC during the neolithic age in Japan clay-fired pottery (containing mica, iron, and aluminum) were used in water purification when water was stored in those kinds of vessels. From century to century the level of technology and water quality standards (national or international standards like that of World Health Organization) has been advancing. The water source quality dictates the appropriate technology to be used as it is directly related to the intended contaminant/pollutant to be removed, most important is the consideration of the capital and operational cost. The water purification technologies range from thermally based to non-thermally based technologies. The thermally based technologies involve the use of heat, which means the source of energy is very important to consider as it is an energy intensive process. For example, it is worth adding thermally based water purifiers in some power plants in which the waste heat can be used in improving the quality of the water. The non-thermally based water purification technologies are of various types, i.e. membrane based (with or without high pressure) and non-membrane based (with power or without power). It is crucial to choose the proper water purification technology based on the type pollutants, production capacity, and energy requirements, and associated costs (both operational and capital cost).

KEYWORDS: *Water, Purification Technology, Energy, Power Plant, Pollutants*

ICEWS-Keynote-3

CONJUNCTIVE MANAGEMENT OF WATER RESOURCES AS A SOLUTION FOR WATER AND ENERGY CHALLENGES

Prof. Dr. Vishnu Prasad Pandey [1,2]
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ABSTRACT:
Water and energy challenges constrain irrigation supply, food production and food security in many agrarian regions across the globe. They are further aggravated by climate variability and change. Appropriate planning and implementation of strategies for conjunctive management (CM) of surface and groundwater resources could offer a solution to address part of the challenges. While there is generic understanding of conjunctive use, in many instances such practices are happening without planning, a thorough CM planning is yet to realize in many command areas. In this context, this keynote presents a holistic framework for assessing CM and implementation prospects from a system-level perspective with a case of Southern Plain in Western Nepal and discusses its wider implications to other regions such as in Pakistan. Results of demonstration of the framework in the case study area in Nepal shows that knowledge of water resources availability is good and that of water demand low. Additional and coordinated investments are required to improve knowledge gaps as well as access to irrigation. There is therefore a need to assess water resources availability, water access, use and productivity, to fill the knowledge gaps in order to pave pathways for CM. Further, this talk also discusses some strategies to translate prospects of conjunctive management into implementation.

KEYWORDS: *Water, Energy, Food, Climate, Irrigation*

ICEWS-Keynote-4

MULTIDIMENSIONAL PROCESSING OF CONVENTIONAL SCANNING ELECTRON MICROSCOPY IMAGES: INSIGHTS INTO BETTER UNDERSTANDING OF THE RESERVOIR FLUID FLOW BEHAVIOR

Prof. Dr. Naser Golsanami[1]
[1]College of Energy and Mining Engineering, Shandong University of Science and Technology, Qingdao, 266590, P.R. China
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ABSTRACT:
In this study, we introduce a novel technique for depth-slicing two-dimensional (2D) SEM images, enabling three-dimensional (3D) processing of conventional SEM data. This method allows for the analysis of phenomena occurring at different depths within the images. While 3D FIB-SEM imaging is a well-known technique, it is important to note that most existing SEM recordings are 2D images. This is because FIB-SEM is a relatively new and expensive method, often unavailable and not applicable to pre-existing 2D SEM datasets. Additionally, most laboratory equipment currently in use is still limited to capturing 2D images. Our 3D depth-slicing technique involves extracting depth information from 2D SEM images using the joint analysis of grayscale density plus the phenomenon distribution pattern, followed by pixel clustering and mineral grouping and pore-fracture identification based on their apparent depth. This approach provides a cost-effective and accessible alternative for obtaining 3D insights from conventional 2D SEM images, offering valuable implications for understanding reservoir fluid flow behavior.
***K*EYWORDS:** *SEM, FIB, Reservoir Fluids, Fracture, Joint, Pores*

ICEWS-Keynote-5

DRIVING SUSTAINABILITY IN WATER PURIFICATION: THE ROLE OF INTEGRATED CDI AND SALINITY GRADIENT POWER SYSTEMS

Dr. Muhammad Wajid Saleem[1]

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ABSTRACT:

The escalating global water demand and diminishing freshwater resources necessitate sustainable desalination technologies. Water scarcity leads to significant challenges worldwide. Capacitive deionization (CDI) has emerged as an energy-efficient electrochemical method for purifying low-salinity water. This study addresses the performance improvement of CDI system by integrating it with salinity gradient power generation (SGP) technologies, including pressure-retarded osmosis (PRO), reverse electro dialysis (RED), and capacitive donnan potential (CDP), to reduce overall energy consumption. The core objective is to partially recover the energy utilized in desalination by using the salinity gradient produced during the CDI process. To achieve this, a multi-pass desorption method in CDI was employed to generate a higher concentration gradient in the rejected brine. This concentrated effluent serves as an effective feed for SGP systems. Key findings reveal significant energy savings through process integration. For instance, integrating CDI with CDP reduced energy consumption for water production from 1.4 kJ/l to 0.35 kJ/l, a saving of approximately 75%. Similarly, the integration of CDI with PRO resulted in a decrease in energy consumption from 2.2 kJ/l to 0.67 kJ/l, representing an energy saving of about 69.5%. Furthermore, in CDI-RED energy consumption of 1.5 kJ/l was reduced to 0.58 kJ/l. In conclusion, the integration of CDI with SGP systems, presents a valuable and insightful approach towards significantly reducing the energy footprint of desalination, fostering more sustainable water purification practices and mitigating environmental concerns associated with energy-intensive desalination processes and brine disposal. Moreover, this innovative multi-pass approach adopted for CDI integration with SGP systems has also improved the water recovery of the system, reaching about 90%, compared to the 50% of a simple CDI system.

***K*EYWORDS:** *Water-Energy Nexus, Energy Recovery, Water Recover, Blue Energy, Energy Efficiency*

ICEWS-Keynote-6

SCOPE OF ENHANCED OIL RECOVERY (EOR), ESPECIALLY IN PAKISTAN

Prof. Dr. Muhammad Sagir[1]
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ABSTRACT:
The necessity for effective hydrocarbon recovery techniques has grown as global energy requirements continue to rise. In order to maximize the utilization of resources, increasing the recovery factor, and prolong the productive life of established oil fields, enhanced oil recovery (EOR) techniques are essential. EOR includes gas, chemical, and thermal injection techniques, all of which are intended to increase reservoir sweep and oil displacement efficiency. Despite the fact that these technologies have been widely adopted globally, Pakistan has yet to adopt them because of infrastructure, financial, and technical limitations. Pakistan has enormous potential for EOR deployment in spite of these obstacles. The nation has a number of established oil fields where EOR can greatly increase recovery rates, including those in the Potwar Basin, Lower Indus Basin and Upper Indus Basin. Because industrial CO_2 emissions can be recycled for oil recovery while having a smaller environmental impact, CO_2 injection is especially promising. Onshore fields with deteriorating waterflood performance have also demonstrated the viability of polymer flooding. The absence of specialized knowledge, significant capital expenditures, and technological constraints continue to prevent wider use. Pakistan's oil industry can expedite the adoption of EOR by establishing prototype EOR projects, encouraging industry-academia collaboration, and providing incentives for international investments. The role of EOR in Pakistan will be thoroughly discussed in the presentation, which will address policy frameworks, technical viability, economic viability, and international best practices. Additionally, a plan for integrating EOR technology into Pakistan's upstream oil industry will be developed, emphasizing the need for government support, industry collaboration, and research and development expenditures. Pakistan may improve its energy security, lessen its reliance on imports, and guarantee sustainable hydrocarbon output for years to come by utilizing EOR.

KEYWORDS: *Enhanced Oil Recovery, Pakistan, CO_2 Injection, Polymer Flooding, Thermal EOR, Microbial EOR, Energy Security, Oil Production.*

ICEWS-Keynote-7

AN ENGINEERING APPROACH TO GENERATE ELECTRICAL ENERGY FROM GEOTHERMAL HEAT TRAPPED IN OIL AND GAS RESERVOIRS

Prof. Dr. Amir Mahmood Soomro[1*] and Dr. Ubedullah Ansari[1]
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ABSTRACT:
Sindh province is facing an energy crisis and weak energy management but rich with geothermal energy. However, the issue of energy crisis is serious across Pakistan but the districts with high mobile areas are dealing with crisis in deep impact. Therefore, this study is proposed to find ways to tap into the heat from oil and gas reservoirs to improve energy mix at national level. This research deep dives into how technically possible, cost-effective, and environmentally friendly this approach is. By practicing this, it is expected to offer a sustainable and innovative energy source that lessens our dependence on traditional fossil fuels and helps make Pakistan's energy supply more diverse and stable. The methodology of this study included lab experiments using a PVT analyzer to measure the heat potential extractable from hot oil and gas reservoirs. Additionally, a MATLAB-based simulation model was developed to estimate the enhancement in Pakistan's energy mix. The combination of experimental data, mathematical modeling, and simulation provided a comprehensive analysis of the feasibility and impact of proposed energy solution. The outcomes of this suggest that from a 130°C hot reservoir producing 1500 barrels of hot water daily, approximately $10.5x10^7$kJ of heat energy can be extracted each day. When converted to electricity with a typical efficiency of 10%, this equates to around $10.5x10^7$kJ kJ or 2,918 kWh of electrical energy daily. Given that the average household in Pakistan consumes about 150 kWh of electricity per month (5 kWh per day), this setup could power approximately 583 households. Assuming an average household size of five people, approximately 2,915 individuals will enjoy this. This method, which is novel and very important because it allows significant amounts of electricity to be generated from a resource that had not been tapped into before, also assists in easing the energy crisis in Pakistan. By reducing dependency on conventional fossil fuels and filling up the energy mix with sustainable sources, this approach provides a significant increase in energy security and accessibility thus benefiting thousands of people.

KEYWORDS: *Electrical Energy, Geothermal Heat, Fossil Fuels, Oil & Gas Reservoirs, Trapped*

ICEWS-Keynote-8

UV-ASSISTED SYNTHESIS AND CHARACTERIZATION OF NANO-CERAMIC FILLER COMPOSITE ELECTROLYTES FOR METAL BATTERY ENERGY STORAGE

Dr. Sajid Hussain Siyal[1]
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ABSTRACT:
Lithium-metal batteries (LMBs) are promising energy storage devices due to the high capacity and minimum negative electrochemical potential. Their concrete applications remain disturbed by unbalanced electrolyte-electrode interfaces, limited electrochemical window, and high-risk. Herein, a novel strategy to prepare ceramic-based electrolyte that possess great potential in energy storage due to their higher level of energy densities in LMBs. lanthanum titanate (LTO) and Aluminum Titanium Phosphate (LTP) film developed via the UV system, aimed to prepare flexible Li+ interpenetrating network film to integrate the ceramic structure with polymer to yield the free-standing electrolyte film for better battery safety and desired interfacial stability. The electrolyte presented a satisfactory electrochemical performance, including, good ionic conductivity, large transference number, and wide electrochemical stability window (ESW) at room temperature. The fundamental function of nano fillers is to support building a stable (SEI) and limits the growth of dendrites. Thus, prepared ceramic-based electrolytes effectively renders to inhibit lithium dendrite growth in a symmetrical cell during charge/discharge at a current density of 2 mA/cm2 above standards without short-circuiting at room temperature. The battery assembled that exhibits superior cyclic stability with high columbic efficiency. This work recommends that the structures of Li-ion conductor help to design a prime solution of promising electrolyte for high-performance applications.

***K*EYWORDS:** *LATP, lithium-metal Batteries, UV, Electrolyte, SEI*

ICEWS-Keynote-09

WATER PRODUCTIVITY ENHANCEMENT USING SENSOR TECHNOLOGY

Dr. Yasir Niaz*[1], Muhammad Ashraf[1], Mohsin Hafeez[1]
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ABSTRACT:
Effective irrigation scheduling plays an important role for water management at a field scale. Therefore, this research provided the evidence for efficiently utilizing irrigation supplies through sensor-based systems. In this regards, eight (8) WiFi sensors were installed at the various locations in district Rahim Yar Khan. The basic information and initial data that was collected during the installation campaign was managed using the Kobo Toolbox. The data includes crop and soil type, location of sensors installation, field boundary, allocated irrigation time, farmer's detail etc. During the field visit, farmers were provided training for the operation of sensors and scheduling their irrigation plan accordingly. Sensors were claimed using the VIA website and all relevant information was added in the website to monitor the data remotely. The map of the location for the sensors was prepared in QGIS. This report also provides interesting insight into the irrigation schedule followed by different farmers. Analysis of the sensor's data reveals that the irrigation was provided relatively at drier conditions during the later crop stages and vice versa. The majority of farmers irrigated their fields during the moist condition. It is noteworthy to mention that the fields irrigated during moist or dry conditions resulted higher crop productivity. These results reveal that irrigation scheduling based on soil moisture sensors have significant potential for water saving and increasing crop and water productivity.

***K*EYWORDS:** *Water Management, Sensors, VIA, QGIS, Irrigation*

ICEWS-Keynote-10

INNOVATIVE SOLUTIONS FOR ENERGY AND WATER CHALLENGES FOR SUSTAINABILITY ALIGNED WITH SUSTAINABLE DEVELOPMENT GOALS–SDGS

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ABSTRACT:
Energy and water are the twin pillars of sustainable development, playing a crucial role in economic growth, environmental preservation, and social well-being. However, increasing global demand, resource depletion, and climate change have intensified the challenges of ensuring energy security and water sustainability. This talk explores innovative solutions for addressing these challenges through emerging technologies, policy frameworks, and interdisciplinary research, aligning with the United Nations Sustainable Development Goals (SDGs) particularly SDG 6 (Clean Water and Sanitation) and SDG 7 (Affordable and Clean Energy). The discussion will highlight advancements in unconventional hydrocarbon recovery, enhanced oil recovery (EOR), and well cementing technologies, emphasizing their role in minimizing environmental footprints while ensuring energy efficiency. Additionally, sustainable water management practices, including advanced filtration, desalination, and water recycling methods, will be explored as viable solutions for meeting industrial and community water needs. Furthermore, the talk will underscore the significance of research, innovation, and policy integration in fostering sustainable solutions for energy and water challenges. Special attention will be given to regional perspectives, including Pakistan's ongoing efforts to enhance laboratory research, academic collaborations, and industry-academia partnerships to drive sustainable energy and water solutions. By bridging the gap between technology, sustainability, and policy, this session aims to provide insights into practical pathways for achieving a balanced, resource-efficient future while advancing the SDGs.

***K*EYWORDS:** *Clean Energy, Water, SDGs, Enhanced Oil Recovery, Sustainability*

ICEWS-Keynote-11

FROM LEGACY TO INNOVATION: LEVERAGING HYDROCARBON EXPLORATION SUCCESSES FOR SUSTAINABLE ECONOMIC GROWTH AND ENERGY SECURITY OF PAKISTAN

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ABSTRACT:
The discovery of oil and gas reserves in the early 20th century transformed the Indus Basin, with over 1,300 wells drilled and 480 discoveries, including 64.4 TCF of gas and 1.25 billion barrels of oil, positioning Pakistan as a rising star in the global energy sector. The Sui gas field, with 13 TCF reserves, transformed Pakistan's industrialization, supported by rapid infrastructure development and subsequent discoveries in Sindh and Baluchistan. These achievements have elevated Pakistan's technical expertise, with professionals now contributing to global energy projects. In mature basins like the Indus, exploring diverse geological formations alongside new basins such as Baluchistan, Makran Offshore, and Indus Offshore is critical. A balanced approach combining advanced geoscience, reservoir engineering, and high-quality 2D/3D seismic data, supported by modern acquisition, processing, and innovative drilling technologies, is key to maximizing exploration and development. To enhance production from mature, declining, and heavy oil fields, deploy advanced Artificial Lift methods (ESPs, gas lift) alongside thermal techniques (steam injection, in-situ combustion) and chemical EOR. Combining innovative drilling, reservoir monitoring, hybrid approaches, and real-time data analytics can maximize recovery, and improve efficiency. The industry's success has also highlighted the need for our universities and research institutes to serve as manufacturing units for future human resources. These institutions must train students with state-of-the-art technological knowledge and ensure they are well-versed in the latest industry developments to meet growing needs.

***K*EYWORDS:** *Hydro Carbon, Energy, Geological Formation, Technologies, Enhanced Oil Recovery*

ICEWS-Keynote-12

SOUTH ASIAN ENERGY LANDSCAPES: REGIONAL PERSPECTIVE ON PAKISTAN'S ENERGY TRANSITION AND THE ROLE OF RENEWABLE ENERGY INTEGRATION

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ABSTRACT:
South Asia's energy landscape is deeply fragmented. India, despite coal dominance (55%), has scaled solar capacity to 73 GW through competitive auctions and policy consistency. Bangladesh achieved 95% electrification via decentralized solar home systems, while Nepal and Bhutan export hydropower to stabilize revenues (IEA, 2023; ADB, 2023). In contrast, Pakistan's RE growth is stifled by institutional inertia, grid limitations, and fossil fuel subsidies—issues compounded by climate shocks, such as declining hydropower output (30% drop at Tarbela Dam in 2022) and heatwave-driven demand spikes (NEPRA, 2023). Pakistan's persistent energy crisis, characterized by significant power deficits (6-8 GW), substantial circular debt (PKR 2.6 trillion), and a heavy reliance on imported fossil fuels (67% of the energy mix), reflects broader energy challenges across South Asia. This study conducts a comparative analysis of Pakistan's energy sector within the regional context, contrasting its limited renewable energy (RE) integration (4%) with the advancements of neighbouring nations, including India (38% RE), Nepal (92% hydropower), and Bhutan (99% hydropower). Despite Pakistan's substantial solar (2.9 million MW) and wind (50,000 MW in Sindh) potential, regional exemplars demonstrate viable pathways towards energy security. This analysis investigates the factors hindering Pakistan's RE adoption, including institutional inertia, grid infrastructure limitations, and entrenched fossil fuel subsidies, exacerbated by climate-induced shocks such as reduced hydropower output and heatwave-driven demand spikes. The critical regional comparison reveals policy inconsistencies, such as fluctuating solar tariffs and inadequate decentralized energy models, as key impediments. Conversely, successful regional initiatives, including India's competitive auction mechanisms, Bangladesh's micro financed solar home systems, and Nepal's cross-border hydropower trade, offer valuable insights. Quantitative and graphical data highlight stark disparities in rural energy access and RE deployment. Given these challenges, it is necessary to, this study advocates for the adoption of regional best practices, grid modernization, the phasing out of fossil fuel subsidies (PKR 500 billion/year), and the prioritization of decentralized RE solutions. This transition necessitates strong political will, regional collaboration (e.g., CASA-1000 grid), and equitable policies to transform Pakistan's energy sector. By leveraging lessons from South Asia's successes and failures, this analysis underscores the critical role of RE integration as a socio-economic imperative for Pakistan's sustainable development.

KEYWORDS: *Renewable Energy, Fossil Fuels, Grid, Dam, Sustainability*

ICEWS-Keynote-13

ENERGY SECURITY OF PAKISTAN: PROSPECTS, CHALLENGES AND RECOMMENDATIONS

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ABSTRACT:
Pakistan's energy landscape for the fiscal year 2022-23 reveals a mix of trends and developments that are significantly impacting the nation's energy dynamics. It has historically relied on fossil fuels to meet the country's energy needs (in particular, natural gas and oil) which is undergoing a critical transition; the country is on the verge of an energy revolution. The strategic objectives in this period revolve around strengthening energy growth, energy efficiency, and strategically reducing dependence on imports. Such objectives not only promise a more consistent and diversified energy supply but can further help shore up stability in the economy. Indigenous energy production, contributing 61% i.e. 51 million tons of oil equivalent (MTOE) to the energy mix, is effectively complemented by substantial energy imports, accounting for the remaining 39% i.e. 33 MTOEs reflecting a balanced energy equation for Pakistan. This synergy between domestic production and imports is an important determinant of Pakistan's energy balance. During this period, Pakistan recorded a major commercial energy supply dynamics conversion, down from 94 to 83 MTOE compared to the previous year. This shift can be attributed to the contrasting performances of different energy sources. Notably, the supplies of nuclear and Hydel electricity recorded a significant year-on-year increase of 35.39% and 12.04% respectively, emphasizing the growing significance of clean and green energy in Pakistan's power generation. Additionally, Liquefied Petroleum Gas (LPG) saw an increase of 2.59%, contributing to the diversification of energy sources. Conversely, several other energy sources experienced a decrease in supply. Overall, the primary commercial energy supply mix in 2022-23 witnessed a substantial decrease of 12.1%, primarily driven by a reduction in imports. Energy security remains a top priority of the government, with an emphasis on increasing self-reliance, to reduce dependence on imported fossil fuels. The government plans to enhance the low-cost, green, and clean energy in the form of Hydel power generation which demonstrates the commitment to diversify the energy mix and promote sustainability. To boost the domestic production and reduce reliance on imported resources for exploration and drilling, the government is focusing on auctioning of various offshore oil and gas exploration blocks. This move aims to attract investment and uncover potential reserves. Additionally, the government encourages the responsible use of natural gas resources to counter the challenges posed by diminished supplies. Together, these measures represent a cohesive strategy to improve energy production, tackle supply challenges, and delve into new opportunities for resource exploration and energy security in Pakistan.

KEYWORDS: *Energy Security, Energy Crises, Oil and Gas Supply Chain, Fossil Fuels, Import Bill Reduction, Foreign Exchange Savings*

ICEWS-Keynote-14

NAVIGATING THE FUTURE OF ENERGY: MARKET DYNAMICS, UNCONVENTIONAL RESOURCES, AND SUSTAINABLE HYDROCARBON DEVELOPMENT

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ABSTRACT:
The global energy landscape is undergoing rapid transformation, shaped by fluctuating market demands, geopolitical influences, and the growing push for sustainability. Oil and gas remain the backbone of global energy security, yet their supply dynamics are increasingly complex due to shifting policies, technological advancements, and the emergence of unconventional hydrocarbon resources. This talk delves into the evolving energy market, analyzing current trends in global crude oil and natural gas demand, supply chain disruptions, and the role of major producers in stabilizing energy prices. A significant focus will be placed on unconventional resource exploitation, including shale gas, tight oil, and deepwater hydrocarbons. Technological innovations such as hydraulic fracturing, enhanced oil recovery (EOR), and digital oilfield solutions are revolutionizing hydrocarbon extraction while aiming to minimize environmental impact. Additionally, the discussion will explore strategies for reducing the carbon footprint of petroleum operations, incorporating carbon capture, utilization, and storage (CCUS), and improving energy efficiency in upstream and downstream sectors. Furthermore, this session will assess the role of national energy policies in shaping the future of fossil fuels, particularly in the context of energy security and the transition towards a diversified energy mix. By examining case studies from key oil and gas-producing nations, including Pakistan and the broader South Asian region, this talk will highlight the importance of sustainable resource development, industry-academia collaboration, and policy integration. The session aims to provide a comprehensive outlook on the challenges and opportunities within the petroleum sector, offering insights into how the industry can navigate the dual objectives of meeting global energy demand while progressing towards a low-carbon future.

***K*EYWORDS:** *Unconventional Resources, Oil and Gas, EOR, CCUS, Energy Demand*

ICEWS-Keynote-15

WASTEWATER-DERIVED NANOMATERIALS FOR ENERGY APPLICATIONS: AN INNOVATIVE APPROACH TO SUSTAINABILITY

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ABSTRACT:

The transition to sustainable energy solutions necessitates the integration of circular economy principles to optimize resource utilization while mitigating environmental challenges. This study explores the potential of wastewater-derived nanomaterials as an innovative solution for enhancing energy storage, improved oil recovery (IOR), and hydrogen geo-storage. Specifically, it investigates the wettability alteration of carbonate rock formations using alumina nanofluids and methylene blue (MB), a prevalent industrial dye found in wastewater from pharmaceutical, textile, and food industries. While MB contamination poses a significant environmental threat, its utilization in engineered nanofluids presents a dual-purpose strategy for environmental remediation and energy optimization. This research evaluates the wettability modification of Sui Main Limestone (SML) core samples treated with alumina nanofluids (0, 0.05, 0.3, 0.50, 0.75, and 1.0 wt.%) and MB solutions (10, 15, 30, 50, and 100 mg/L) under controlled thermal conditions (25°C and 50°C) over a 7-day exposure period. The results demonstrate a significant shift from an oil-wet to a water-wet state, highlighting the efficacy of wastewater-derived nanomaterials in optimizing rock-fluid interactions for sustainable energy recovery and storage. By repurposing industrial wastewater into functional nanomaterials, this study presents an innovative pathway for addressing energy and water challenges through circular economy-driven solutions. The findings emphasize the transformative potential of integrating environmental sustainability with advanced energy technologies, paving the way for greener and more efficient resource management strategies.

KEYWORDS:*Nanofluids, Sustainable Energy, Wettability Alteration, Improved Oil Recovery*

ICEWS #09

ECO-FRIENDLY TRANSFORMATION OF COAL FLY ASH INTO ZEOLITE X: A SUSTAINABLE APPROACH TO ENHANCING WASTEWATER TREATMENT

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ABSTRACT:
Converting coal fly ash into Zeolite X via hydrothermal method is an effective and sustainable way to convert industrial waste into a high value material. This study explores the conversion of coal fly ash into Zeolite X through alkali fusion followed by hydrothermal crystallization. The key synthesis parameters such as alkali concentration, reaction temperature and crystallization time were optimized to get high purity and crystallinity. The synthesized Zeolite X was characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), Energy-dispersive X-ray Spectroscopy (EDS) and Thermo gravimetric analysis (TGA).The obtained Zeolite X was further evaluated for wastewater treatment applications through adsorption mechanism. Its high surface area, well defined pore structure and negative surface charge enabled efficient adsorption of heavy metal ions and organic pollutants from aqueous solutions. Adsorption kinetics and isotherm studies showed the Adsorption behavior is described by isotherm models (Langmuir, Freundlich) and kinetic models (pseudo-first-order, pseudo-second-order, intraparticle diffusion) for the adsorption rates. Knowing these models will help us to optimize zeolite for heavy metal and pollutant removal. Langmuir and pseudo-second order models, indicating monolayer adsorption and chemisorption interactions. The results shows that Zeolite X from coal fly ash is an economical and ecofriendly adsorbent for wastewater treatment.

KEYWORDS: *Coal Fly Ash, Wastewater Treatment, Ecofriendly, Industrial Waste*

ICEWS #10

EVALUATION OF WATER, SANITATION, HYGIENE (WASH), AND MANAGEMENT PRACTICES IN A BASIC HEALTH UNIT, HYDERABAD

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ABSTRACT:

Water, sanitation, and hygiene (WaSH) serve as fundamental pillars for safeguarding public well-being, curbing waterborne illnesses, and promoting sustainable progress on a global scale. This study employed the Fill Wash-Fit External Follow-Up Questionnaire along with water specimens to evaluate WaSH-related practices. The findings indicated that 58.4% of the total WaSH indicators achieved the benchmark, 20% were partially fulfilled, and 21.6% fell short. 50% of the indicators reached the set standard regarding water quality measures. Sanitation practices demonstrated remarkable efficiency, with 77.3% of the indicators attaining the target. Hygiene conditions met 61.1% of the specified benchmarks. However, management strategies proved to be the weakest aspect, with only 27% of indicators meeting expectations due to insufficient supervision, inadequate staff training, and non-compliance with governmental regulations. The drinking water samples complied with permissible physical and microbial safety standards, with parameters such as pH, electrical conductivity (EC), turbidity, and total dissolved solids (TDS) remaining within acceptable thresholds. Additionally, no hazardous pathogens were detected, affirming the water's suitability for human consumption. Strong positive correlations were observed between Water, Sanitation, and Hygiene, highlighting their interdependence, while Management showed strong negative correlations with all three, emphasizing its crucial role in mitigating WaSH challenges. This research highlights the necessity for specialized training initiatives, consistent oversight, and infrastructure enhancements to strengthen WaSH protocols at the Basic Health Unit (BHU). The findings offer a strategic approach to bridging existing gaps and improving healthcare service delivery in comparable environments.

KEYWORDS: *Water, Sanitation, Hygiene, Management, Practices*

ICEWS #15

STEEL PIPELINE CORROSION FAILURES IN OIL AND GAS FIELDS: A REVIEW

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ABSTRACT:
Steel pipeline corrosion in oil and gas fields is a critical issue that poses significant safety, environmental, and economic challenges. This review examines the primary causes of corrosion, including electrochemical reactions, microbiologically influenced corrosion (MIC), CO_2 and H_2S corrosion, and stress corrosion cracking (SCC). It highlights the common types of corrosion failures, such as pitting, uniform corrosion, and cracking, and discusses the factors influencing corrosion, such as environmental conditions, material properties, and operational practices. The consequences of corrosion failures, including safety risks, environmental damage, and economic losses, are also explored. Mitigation strategies, such as material selection, coatings, cathodic protection, corrosion inhibitors, and advanced monitoring techniques, are reviewed to provide a comprehensive understanding of current practices. Additionally, the paper discusses emerging technologies, including smart pigging, predictive modeling, and nanotechnology, that are shaping the future of corrosion management. Despite advancements, challenges such as aging infrastructure, harsh operating environments, and the need for sustainable solutions remain. This review underscores the importance of a proactive and integrated approach to corrosion management to ensure the safe and efficient operation of oil and gas pipelines.

KEYWORDS: *Corrosion, Electrochemical Reactions, Cathodic Protection*

ICEWS #16

A STUDY OF COCONUT FIBRE AS A LOSS CIRCULATION MATERIAL IN DRILLING FLUIDS: AN EXPERIMENTAL INVESTIGATION

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ABSTRACT:

The exploration of hydrocarbons is vital for the growing oil and gas industry, yet drilling operations face significant challenges, including the loss of drilling fluid circulation. This issue is particularly critical in highly permeable formations and fractured zones, where fluid loss can reduce hydrostatic pressure, increasing well control risks due to formation fluid influx. This study investigates the potential of coconut fiber as a loss circulation material (LCM) in water-based drilling fluids. Different particle sizes of dried coconut fiber (i.e., 500 µm, 710 µm, and 1 mm) were tested at equal weights (5g) under controlled conditions of 150 °C and 100 psi using an API filter press. The results indicate that 500 µm dried coconut fiber was the most effective in minimizing fluid loss and forming a robust, impermeable mud cake. Additionally, the impact of burnt coconut fiber was examined at concentrations ranging from 1.5g to 15g, revealing that 1.5g of burnt coconut fiber provided optimal fluid loss reduction. These findings highlight the potential of coconut fiber as a cost-effective and chemically neutral LCM, offering a sustainable alternative for improving wellbore stability and mitigating drilling fluid loss.

KEYWORDS: *Coconut Fiber Additives, Fluid Loss Control, Wellbore Stability, Loss Circulation Material*

ICEWS #20

EXPLORING GROUNDWATER RESOURCES AND QUALITY THROUGH ELECTRICAL RESISTIVITY SURVEYS

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ABSTRACT:

A geophysical resistivity survey was conducted in Taluka Sanghar to evaluate groundwater resources for drinking and agricultural purposes. Three profiles, each comprising four Vertical Electrical Sounding (VES) points spaced 3 kilometers apart, were analyzed using the Schlumberger electrode configuration and IPI2-win software. The study identified four lithological units: sand, silty clay, sand clay, and silty sand. The first profile, located in the northeast near the Chotiari reservoir, revealed a freshwater aquifer at 32-37 meters, brackish water at 95-115 meters, and highly saline water at 110-135 meters. The second profile indicated a saline water aquifer at 30-90 meters and highly saline water at 95-120 meters, while the third profile showed a freshwater aquifer at 30-35 meters, brackish water at 115 meters, and highly saline water at 115-130 meters. The Chotiari reservoir serves as the primary recharge source; however, excessive seepage has led to waterlogging, increased salinity, and soil degradation, particularly in the second profile, negatively impacting agricultural productivity in the region.

KEYWORDS: *Geophysical Resisitvity, Ground Water, Salinity, Aquifer, Agricultural*

ICEWS #21

PHYSICOCHEMICAL EVALUATION OF WATER QUALITY IN HYDERABAD CITY TO DETERMINE THE SOURCES OF POLLUTION

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ABSTRACT:

The fundamental chemical and physical characteristics of water are assessed in a physicochemical evaluation to pinpoint the pollution sources and establish the water's safety. This study aims to evaluate the water quality in Hyderabad urban, drainage, and treated sources, such as Wadera Goth Colony, NWSTP (Inlet and Outlet), Pinyari Drain, Gafoor Shah Colony, Kalimori, Deplai Memon Colony, and Fateh Chowk. Frequent water monitoring is essential to the sustainability of the environment and public health in light of the fast urbanization and industrial expansion. The physical-chemical assessment of water quality determines if the water is suitable for human consumption by identifying the sources of contamination using basic chemical and physical standards. This research looks at Hyderabad's water quality from many urban, drainage, and treated sources, including Wadera Goth Colony, the Phuleli Canal, the Phuleli Channel, the NWSTP (Inlet and Outlet), and the Pinyari Drain. To measure vital parameters including pH, turbidity, electrical conductivity (EC), total dissolved solids (TDS), and total organic carbon (TOC), traditional methods were employed. The results showed that the EC was highest in Wadera Goth Colony (5696 µS/cm) and lowest at NWSTP Inlet (12.47 µS/cm). TDS was lowest (1.482 mg/L) at the NWSTP discharge and highest (880.75 mg/L) at Pinyari Drain. The turbidity is maximum in Gafoor Shah Colony (134.33 NTU) and lowest in the Phuleli Canal and Channel (34.5 NTU). The excessive TOC at the NWSTP input (159.8 mg/L) and the significant decrease at the outflow (11.50 mg/L) demonstrated effective treatment. These results provide major variations in water quality, with treated water with a notable improvement and areas of urbanization having greater pollution levels. Reducing pollution, treating wastewater effectively, and managing water resources sustainably all depend on focused actions and constant surveillance.

KEYWORDS: *Physicochemical Analysis, Water Quality Parameters, TOC, pH, Electrical Conductivity, TDS, Turbidit*

ICEWS #23

COMPOSITIONAL ANALYSIS OF WAXY CRUDE & PREDICTION OF WAX DEPOSITION IN CRUDE OIL PIPELINE AT LOW TEMPERATURE

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ABSTRACT:

Wax deposition poses a significant challenge to flow assurance in oil and gas pipelines, impacting operational efficiency and causing blockages over time. This phenomenon occurs due to cooling of crude oil during transport, leading to the precipitation and buildup of wax on pipeline walls. Managing this issue requires an integrated approach, combining experimental analysis and computational simulations. This study explores wax deposition mechanisms using laboratory tests such as wax appearance temperature (WAT), pour point temperature, and SARA analysis. These experiments are complemented by the MATZAIN model implemented in MATLAB to predict wax deposition behavior in an onshore pipeline, providing insights into wax layer thickness, operational impacts, and mitigation strategies. A waxy crude oil sample was analyzed to assess its composition and behavior under varying conditions. Laboratory tests revealed that 0.10 mm of wax was deposited within the pipeline's direction on the first day. WAT was observed 1-2 km along a 25 km pipeline. MATLAB simulations predicted that wax deposition would increase to 0.75 mm by the seventh day, eventually reaching a thickness of 3 cm within 30 days, resulting in complete blockage of the pipeline. The study offers a novel approach by integrating experimental data with predictive computational modeling, enabling accurate prediction of wax deposition under specific operational conditions. Key outcomes include identifying pressure, and temperature drops and estimating optimal pigging frequency for maintenance. This study provides a comprehensive framework for addressing wax deposition challenges, combining real-world data with advanced simulation techniques to enhance flow assurance strategies. Future research should focus on refining wax deposition models, improving wax inhibition technologies, and further integrating laboratory findings with computational simulations to develop robust and effective pipeline management solutions for long-term operations in the oil and gas industry.

KEYWORDS: *Heavy Crude oil, Matlab Simulation. Wax deposition, Temperature*

ICEWS #24

A SIMULATION STUDY OF CO2 INJECTION FOR ENHANCING HYDROCARBON RECOVERY IN OIL SHALE

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ABSTRACT:
The potential of CO2 injection as an Enhanced Oil Recovery (EOR) method to improve hydrocarbon recovery in oil shale formations, with a focus on the Bakken Formation. Oil-Shale reservoirs, despite their significant hydrocarbon potential, present extraction challenges due to low permeability, complex pore structures, and rapid production decline. Primary production methods typically recover only 5–20% of the initial oil in place. CO2 injection is recognized as an effective solution, as it enhances oil displacement efficiency, reduces the viscosity of trapped hydrocarbons, and maintains reservoir pressure to sustain production. A simulation model was developed incorporating average reservoir rock and fluid properties to evaluate the impact of CO2 injection at rates of 1, 2, and 3 MMSCFD. The baseline scenario without injection served as a reference point. While economically viable, CO2-EOR raises environmental concerns, particularly regarding emissions from compression, transportation, and reinjection. The combustion of recovered hydrocarbons releases additional CO2, contributing to climate change. Additionally, CO2-EOR requires substantial energy input, increasing overall greenhouse gas emissions. Despite these challenges, CO2 injection remains a promising method for improving oil recovery in shale formations. Sustainable CO2-EOR applications require balancing economic benefits with responsible resource management. The simulation results demonstrated that CO2 injection significantly increased oil recovery, with recovery factors improving by 50–60% compared to primary recovery methods. The enhanced recovery was attributed to CO2's ability to act as a miscible agent under specific reservoir conditions, improving sweep efficiency and mobilizing trapped hydrocarbons within the tight shale matrix. Prolonged CO2 injection further enhanced oil recovery, reinforcing its potential for hydrocarbon extraction from unconventional reservoirs.

KEYWORDS: *CO2 Injection, Enhanced Oil Recovery, Oil Shale, Simulation, Hydrocarbon Recovery*

ICEWS #26

ASSESSMENT OF PHYSIOCHEMICAL AND MICROBIOLOGICAL QUALITY OF DIFFERENT WATER SOURCES OF JAMSHORO

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ABSTRACT:
Clean water is vital for the well-being of all life forms. Water quality assessment ensures safe drinking water and protects public health. This study evaluates the physicochemical and microbial quality of various water sources in the Jamshoro district, including tap water, bottled drinking water, hostel drinking water, river water, and university department drinking water. These parameters in the laboratory such as pH, total dissolved solids (TDS), turbidity, electrical conductivity (EC), dissolved oxygen (DO), salinity, and microbial contamination (coliform test) were analysed and compared with the World Health Organization (WHO) drinking water standards. The results revealed significant variations in water quality across different sources. River water exhibited the highest turbidity (32.4 NTU) and microbial contamination (340 CFU/100 mL), exceeding WHO standards. Similarly, hostel drinking water showed alarming microbial levels (140 CFU/100 mL), which may raise serious health concerns. Tap water and university department drinking water contained minimal microbial contamination (5 CFU/100 mL), whereas bottled water was completely free of coliform bacteria. These findings highlight critical water quality concerns, particularly in hostel and surface water sources, which pose potential health risks. Moreover, it underscores the need for enhanced water treatment, routine monitoring, and improved sanitation practices to ensure safe drinking water in the region.

KEYWORDS: *Water Quality Assessment, Physicochemical Parameters, Turbidity and TDS, Electrical Conductivity, Water Treatment and Management*

ICEWS #30

SUSTAINABLE, ECONOMICAL, AND ENVIRONMENTALLY FRIENDLY ROAD DIVIDER FROM OLD, WASTE TIRES

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ABSTRACT:
The global surge in automobile numbers, exceeding 2.1 billion by 2020, primarily driven by Asian economic growth, has intensified the problem of discarded tire waste. This waste poses significant environmental and health risks through illegal dumping and storage, leading to disease, fire hazards, and chemical leaching. This research proposes an environmentally conscious solution: road dividers constructed from recycled tires. Utilizing Autodesk Revit, a powerful BIM software, the study aims to develop and analyse these dividers, focusing on material sustainability, cost-effectiveness, and durability. By creating intelligent 3D models, Revit will facilitate the assessment of various design options and their environmental impact. The project explores traditional road divider creation methods, comparing them with the proposed tire-based approach. This analysis includes material analysis, cost comparisons, and durability assessments. The goal is to demonstrate that recycled tire rubber can be effectively used to create eco-friendly and cost-effective road infrastructure. This innovative approach seeks to reduce tire waste, minimize carbon footprints, and contribute to a more sustainable and green future.

KEYWORDS: *Sustainable, Durability, Green Future, Road Divider, Rubber, Eco-friendly*

ICEWS #35

SUSTAINABILITY OF IRRIGATION WATER DELIVERY: PERFORMANCE ASSESSMENT OF PIR GUNIO DISTRIBUTARY AT DADU CANAL

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ABSTRACT:
Efficient irrigation system performance is crucial for ensuring proper water distribution and infrastructure sustainability. This study evaluates the physical condition, maintenance status, and water delivery services of the Pir Gunio Distributary and its two minors, Kharro and Baghban, off-taking from the Dadu Canal. The assessment was conducted using the Rapid Appraisal Procedure (RAP), incorporating field observations and design data obtained from the Irrigation Office, Dadu. Discharge measurements were taken using the current meter (area-velocity method), and key performance indicators—including Delivery Performance Ratio (DPR), Coefficient of Variance (CV), and Tail-End Supply Ratio (TSR)—were analyzed for the Kharif season (June–August 2022). The RAP assessment revealed that the actual water delivery service (0.25) is significantly lower than the reported value (1.8). Several internal performance indicators scored below 2, indicating poor infrastructure conditions. Baghban Minor exhibited the worst condition, lacking essential gates and sections, while Kharro Minor performed relatively well except for canal communication. The DPR analysis classified Pir Gunio Distributary, its second-mile regulator, and Kharro Minor as poor (DPR < 0.7), whereas Baghban Minor showed good performance (DPR > 0.9). The CV results indicated fair performance for Pir Gunio Distributary and Kharro Minor (CV 0.7–0.9), while Baghban Minor and Pir Gunio at the second-mile regulator exhibited good consistency (CV > 0.9). Tail-end water availability (TSR) was 87% for Pir Gunio and 70% for Kharro Minor, indicating satisfactory performance, whereas the second-mile regulator (51.25%) and Baghban Minor (51.42%) showed deficiencies. The findings highlight the urgent need for infrastructure improvements, regular maintenance, and enhanced monitoring to achieve equitable water distribution and optimize system performance.

KEYWORDS: *Hardware Survey, Water Delivery Performance, Pir Gunio, Baghban, Kharro Minor, Dadu Canal*

ICEWS #36

ECO-FRIENDLY BIMETALLIC NANOPARTICLES SYNTHESIZED FROM AZADIRACHTA INDICA AND MORINGA OLEIFERA EXTRACTS FOR ENHANCED INDIGO CARMINE DEGRADATION

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ABSTRACT:
Pakistan is one of the most influential textile sectors in the world, however, textile industries generate more pollutants as 1000 different dyes are used daily, with an expected that textile materials are used in 90% of cases. This study focuses on Indigo carmine (IC) dye, used in denim that is difficult to remove from wastewater. Currently, bimetallic green nanoparticles (NPs) are synthesized using an eco-friendly biochemical precipitation method and characterized through UV-visible spectrophotometry, with a peak at 350 nm confirming the successful formation of the nanoparticle. The synthesized NPs were evaluated for their potential in environmental remediation, focusing on the degradation of Indigo Carmine dye. For the adsorption experiment, different concentrations of Indigo carmine (20mg/l, 40mg/l, and 50mg/l) were used. The results showed that bimetallic nanoparticles (BMNPS) had an excellent elimination rate of indigo carmine (IC) at a concentration of 20mg/l, with a dosage of 270 milligrams of NPs added to untreated textile wastewater at pH 9.45. The mixture was then incubated at 25°C for 120 minutes. The removal efficiency, calculated by comparing dye concentration before and after treatment, indicated a 90.1% dye removal under natural conditions without optimization. These findings indicate that bimetallic green nanoparticles provide a novel, cost-effective, ultrafast and sustainable solution for textile wastewater treatment, demonstrating significant potential for large-scale environmental applications as compared to conventional methods. Furthermore, the use of green synthesis methods ensures reduced toxicity and waste generation, aligning with global efforts toward sustainable industrial practices.

KEYWORDS: *Bimetallic Nanoparticles, Indigo Carmine, UV-Visible Spectrophotometry, Textile Wastewater, Dye Degradation*

ICEWS #37

DEVELOP SUSTAINABLE PROPPANT MATERIAL BY USING FLY ASH AND RECYCLED BAUXITE FOR HYDRAULIC FRACTURING PROCESS

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ABSTRACT:
Hydraulic fracturing, commonly known as fracking, is a crucial technique for extracting hydrocarbons from low-permeability formations such as shale. Proppants, typically composed of sand, ceramics, or bauxite, play a vital role in maintaining fracture conductivity and enhancing hydrocarbon flow. However, dependence on imported proppants increases costs and creates supply chain vulnerabilities. This study investigates the feasibility of using locally available industrial waste—fly ash, a coal combustion byproduct, and bauxite waste obtained via the Bayer process—as sustainable alternatives for proppant production. A series of laboratory experiments were conducted to analyze the physical and mechanical properties of fly ash and bauxite-based proppants. Key parameters assessed include bulk density, particle size, compressive strength, and permeability. The results show that mixtures of fly ash and bauxite exhibit compressive strengths between 15 MPa and 35 MPa and bulk densities ranging from 2.3 to 3.0 g/cm³, aligning with API and ISO standards for ceramic proppants. Permeability calculations using the Fair and Hatch equation indicate that the optimal sample achieves a permeability of 83.4 mD, demonstrating its suitability for hydraulic fracturing applications.
The findings highlight the potential for developing sustainable proppants from industrial waste, reducing environmental impact while enhancing energy security and economic viability. This research supports the transition toward eco-friendly hydraulic fracturing practices by minimizing reliance on imported proppants and optimizing the use of local resources.

KEYWORDS: *Hydraulic Fracturing, Proppants, Fly Ash, Bauxite Waste, Compressive Strength, Permeability, Sustainable Proppants, Energy Security*

ICEWS #38

IMPACT OF IMPROPER SOLID WASTE MANAGEMENT ON HEALTH AND ENVIRONMENT OF NAWABSHAH CITY

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ABSTRACT:

Proper waste management is a fundamental key to environmental sustainability. The municipal solid waste management and disposal methods in Nawabshah city are presented in this study. These waste's characteristics and composition, as well as the environmental issues associated with their management, are also investigated. Environmental and health issues arising from the unsustainable management of the wastes were assessed from oral interviews and field observations in the study areas. The study strongly recommend that Government should seriously consider introducing “waste to energy” as a method of tackling waste management in the metropolitan cities of Sindh also to utilize this waste for energy needs. The results indicate that waste dump sites (designated and non-designated) on major streets and several open spaces are left unattended for long periods of time, causing the rubbish heaps to encroach on the roads, limiting road users' access, generating serious air pollution issues, and comprise a health hazard when blown over by winds, it causes a significant annoyance and blocks the aesthetic view of the Nawabshah city. The results also revealed that the waste composition in the Nawabshah city is heterogeneous because it contains both biodegradable and non-biodegradable materials such as e-waste, plastic, polyethene materials, hospital wastes, and hair designers' wastes, among others. During the study time an oral interview was conducted from the stake holders to identified such diseases i.e., cholera, malaria, dengue fever, respiratory infection and asthma etc. these are the major health problems associated as well as open dumping causes soil and water pollution due to improper dumping municipal solid waste.

KEYWORDS: *Waste Management, Waste Characteristics, Waste to Energy, Diseases, Nawabshah*

ICEWS #39

THE ASSESSMENT OF GROUNDWATER QUALITY AND SUITABILITY IN THE VICINITY OF SMALL DAMS IN LOWER KOHISTAN REGION DISTRICT JAMSHORO

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ABSTRACT:
Groundwater quality and subtility assessment survey were carried out in newly constructed small dams at lower Kohistan area. Geophysical resistivity survey and groundwater sampling were carried out in four small dams. Subsurface resistivity survey were carried up to depth of 100 m 300 feet and groundwater quality sampling were collected surrounding tube wells. The main objective of this study is to carry out a hydrogeological /geophysical survey with the aim to identify and characterize the aquifer systems, groundwater recharge, aquifer depth, groundwater quality and subsurface lithology of aquifers. A 34.8 m thick aquifer were demarcated in Sangchat jo Tarr dam depth from 13 to 47m. A 41.6 m thick aquifer was demarcated in Gurrand dam depth from 19.4 m to 61m. A 22.15 m aquifer were demarcated in Tikho/111 dam depth from 13.24 to 35.39m. A 42.9 m thick aquifer were demarcated in Pipre Baricha dam 9.67 to 52.6 water quality parameters showing that Sangchat jo tarr dam showing high Alkalinity, Hardness, Chloride. High Sodium, Cobalt, Iron and Selenium. Gurrand dam showing high contamination levels in Chemical Parameters, High Iron and Selenium. Tikho showing high TDS, sulphate, Hardness, Chloride and Carbonate. High Magnesium, Potassium, Calcium, Cobalt and Iron. Pipre Baricha dam showing High TDS, Sulphate, Nitrate, Alkalinity and Hardness. High Potassium and Iron. On the basis of results, it is interpreted that these dams play a vital role in recharging subsurface aquifers up to average depth of 10 to 20 feet. water quality analysis showing that groundwater is suitable for irrigation purposes in Sangchat jo tar and Gurrand dam but not recommended for drinking purpose and Tikho and Pipri baricha dams recommended both suitable for drinking and irrigation purpose.

KEYWORDS: *Groundwater Quality, Aquifer Systems, Chemical Parameters*

ICEWS #42

EXPERIMENTAL STUDY TO ANALYZE THE IMPACT OF NANO FLUID STABILITY FOR ENHANCED OIL RECOVERY FEASIBILITY

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ABSTRACT:

This study investigates the formulation and stability of Zinc Oxide (ZnO) and Iron Oxide (Fe_2O_3) nanofluids for Enhanced Oil Recovery (EOR). A major challenge in developing nanofluids is the agglomeration of nanoparticles due to particle collisions, which destabilizes the suspension. To address this, nanofluids were prepared at varying concentrations (0.05, 0.1, and 0.5 wt.%) and analyzed using Dynamic Light Scattering (DLS) and Zeta potential measurements to evaluate particle size distribution, dispersion behavior, and surface charge stability over time. The results indicated that higher nanoparticle concentrations improved stability by reducing aggregation. ZnO nanofluids exhibited superior stability compared to Fe_2O_3, with smaller changes in particle size distribution over time. At 0.5 wt. %, ZnO nanofluids retained better dispersion stability, whereas lower concentrations (0.05 wt.%) showed greater aggregation. Fe_2O_3 nanofluids also demonstrated enhanced stability at higher concentrations, though with more variability in particle size and dispersion compared to ZnO nanofluids. Zeta potential analysis supported these observations, with ZnO nanofluids maintaining stability across all concentrations, as indicated by Zeta potential values above ±30 mV. In contrast, Fe_2O_3 nanofluids showed moderate stability, with slight fluctuations in Zeta potential, especially at lower concentrations. The highest concentration (0.5 wt. %) for both types of nanoparticles consistently demonstrated the best stability due to increased electrostatic repulsion. These findings emphasize the importance of tailoring nanoparticle concentration and type to achieve stable nanofluids. ZnO nanofluids emerged as more stable, making them more suitable for long-term industrial applications such as EOR. Future research should focus on hybrid nanofluids, environmental impacts, and evaluating extended stability under dynamic conditions

KEYWORDS: *Nanofluids, Zeta Potential, Stability, EOR*

ICEWS #45

OPTIMIZING CO_2 STORAGE AND ENHANCED OIL RECOVERY: A GEO-MECHANICAL EVALUATION OF CARBONATED WATER INJECTION VS. WATER FLOODING

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ABSTRACT:

Ensuring long-term containment of CO_2 is essential for the safe geological storage of carbon. While Carbon Capture and Storage (CCS) is a viable approach in depleted hydrocarbon fields, the choice of injection method plays a critical role in maximizing both CO_2 storage efficiency and oil recovery. This study presents an integrated geo-mechanics workflow to evaluate cap rock integrity under two different injection techniques: carbonated water injection and conventional water flooding. The workflow incorporates reservoir simulation to analyze variations in formation pressure and temperature, coupled with geo-mechanical modeling to assess stress changes. These simulations are iteratively coupled until equilibrium is achieved within a given tolerance. The research utilizes ANSYS Fluent for continuous monitoring of CO_2 injection, exploring different water-to-CO_2 ratios to assess their impact on long-term containment and displacement efficiency. By examining the interactions between injected fluids and the reservoir, this study provides insights into how each method influences rock stability, pressure distribution, and CO_2 trapping mechanisms. Additionally, the role of density differences between carbonated water and pure CO_2 in mitigating leakage risks is assessed, particularly in the presence of geological disturbances such as faults or fractures. This comparative analysis aims to enhance the understanding of CO_2 storage strategies, ensuring environmental safety, improving Enhanced Oil Recovery (EOR) efficiency, and advancing the feasibility of CCS technologies.

KEYWORDS: *Carbon Capture and Storage (CCS), Cap Rock Integrity, Geo-mechanical Simulation, Carbonated Water Injection, Enhanced Oil Recovery (EOR)*

ICEWS #46

ENHANCING OPERATIONAL EFFICIENCY IN THE PHARMACEUTICAL INDUSTRY THROUGH VALUE STREAM MAPPING (VSM)

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ABSTRACT:

Value Stream Mapping (VSM) is a lean manufacturing tool used to visualize and analyze production workflows, distinguishing between value-added (VA) and non-value-added (NVA) activities. This study applies VSM in the pharmaceutical industry, specifically in soft gel capsule production, which involves multiple stages, including gel formation, encapsulation, drying, inspection, and packaging. Given the complexity of these operations, inefficiencies such as process delays, extended waiting times, and resource misallocation can significantly impact production speed and overall efficiency. This research aims to identify bottlenecks and improve workflow efficiency through a systematic application of VSM. By mapping the current production process, areas of waste and redundancy are highlighted, enabling targeted improvements. The implementation of VSM is expected to reduce turnaround time, enhance process synchronization, and optimize resource utilization. Additionally, minimizing waste in the production cycle contributes to cost savings and sustainability. The findings indicate that integrating VSM into soft gel capsule manufacturing leads to streamlined operations, improved production speed, and higher product quality. The approach enhances decision-making by providing a clear visual representation of process inefficiencies, making it easier to implement data-driven improvements. Ultimately, this research underscores the importance of lean methodologies in pharmaceutical manufacturing and offers a structured framework for continuous process optimization. The insights gained from this study can serve as a foundation for further research on applying lean strategies to improve efficiency across various pharmaceutical production processes.

KEYWORDS: *Value Stream Mapping (VSM), lean Manufacturing, Pharmaceutical Industry, Soft-gel Manufacturing, Process Optimization*

ICEWS #47

SUSTAINABLE ENERGY PRACTICES AND ISO 50001 IMPLEMENTATION IN A PAKISTANI PHARMACEUTICAL INDUSTRY

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ABSTRACT:

In light of the growing global emphasis on energy efficiency, the pharmaceutical industry, particularly Pakistan, faces increasing pressure to adopt sustainable energy management practices. This study presents an in-depth analysis of the implementation of ISO 50001 – Energy Management System (EnMS) in a Pakistani pharmaceutical company, evaluating its impact on existing energy management frameworks and overall operational efficiency. A key focus of the research is the identification and resolution of challenges encountered during the adoption process, notably the Energy Gap Assessment, which was hindered by the absence of a predefined benchmark for optimal energy consumption. The study systematically explores the entire implementation process, including energy performance evaluations, formulating Internal and External Issues Forms, the identification of Significant Energy Users (SEUs), and the execution of Internal Audits. A significant outcome of ISO 50001 adoption was real-time energy consumption data availability, enhanced decision-making capabilities, and operational transparency. Furthermore, comprehensive documentation, encompassing Standard Operating Procedures (SOPs) and audit reports, was established to ensure regulatory compliance and drive continuous improvement. The findings underscore the crucial role of a structured energy management system in optimizing energy use and fostering a sustainable operational framework within the pharmaceutical sector.

KEYWORDS: *ISO 50001, Pharmaceutical Industry, Energy Gap Analysis, Internal Audit, Energy Management*

ICEWS #48

ENHANCING FEATURE PHONE ASSEMBLY EFFICIENCY THROUGH JAAMSIM SIMULATION

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ABSTRACT:

Optimizing production efficiency is crucial for cost reduction and workflow enhancement in the highly competitive feature phone manufacturing sector. To address this challenge, this study utilizes discrete-event simulation with JaamSim software to analyze and improve assembly line efficiency in a mobile manufacturing company. A simulation model comprising 50 servers in a cellular layout was developed using real-service times and arrival data to identify operational constraints. The analysis revealed inefficiencies at the mic soldering and LED soldering stations, where additional workforce allocation led to resource imbalances. To mitigate this issue, a labor optimization strategy was proposed, involving reducing one worker at each station and a dynamic staffing system that adjusts personnel allocation based on real-time demand. The model was further tested under increased production targets to determine the system's maximum operational capacity and identify potential bottlenecks. Leveraging simulation-based analysis significantly reduced the time required to diagnose inefficiencies, implement corrective actions, and make data-driven decisions. The results demonstrated improvements in assembly speed, workforce distribution, and overall cost efficiency. This research highlights the effectiveness of simulation tools in enhancing manufacturing processes, showcasing their role in continuously optimizing feature phone assembly lines for improved productivity and operational flexibility.

KEYWORDS: *Discrete-event Simulation, Assembly Line Optimization, JaamSim Simulation, Feature Phone Manufacturing, Production Efficiency*

ICEWS #49

IIOT 4.0 ENABLED WASTE MANAGEMENT SYSTEM FOR A DIGITALIZED AND STRUCTURED APPROACH IN THE PHARMACEUTICAL INDUSTRY

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ABSTRACT:

Efficient waste management remains a significant challenge in pharmaceutical manufacturing, necessitating real-time monitoring, regulatory compliance, and data-driven decision-making. This research introduces an Industry 4.0-enabled Industrial Internet of Things (IIoT 4.0) waste management system, integrating hardware and software to enhance waste tracking and analysis. The system employs IIoT protocols for seamless data communication between hardware, cloud infrastructure, and software components, ensuring automated and precise waste monitoring. Key functionalities include daily hazardous and non-hazardous waste tracking, a real-time dashboard with structured and segregated data, and graphical visualizations for enhanced analytical insights. Additionally, the system features waste forecasting, financial analysis of waste-related costs, KPI tracking, and automated gate pass generation, contributing to improved operational efficiency. A notable innovation of this system is its role-based access control, which restricts user access based on job responsibilities, thereby maintaining data security and regulatory compliance. Moreover, the system calculates carbon footprints associated with waste generation and employs predictive analytics to estimate future emissions, reinforcing sustainability efforts. Advanced data filtration techniques further enhance accuracy, enabling more informed decision-making. Experimental results demonstrate improved waste tracking, optimized resource utilization, and strengthened regulatory compliance. This research advances smart waste management in pharmaceutical manufacturing, promoting sustainability, efficiency, and digital transformation through Industry 4.0 innovations.

KEYWORDS: *IIOT 4.0-waste Management System, Pharmaceutical Industry Sustainability, Real-time Waste Monitoring, Data-driven Decision Making, Industry 4.0 Smart Systems*

ICEWS # 50

OPTIMIZING PROCESS EFFICIENCY IN THE MOBILE PHONE INDUSTRY THROUGH VALUE STREAM MAPPING (VSM)

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ABSTRACT:

Value Stream Mapping (VSM) is a Lean management technique that enhances operational efficiency and minimizes bottlenecks in the mobile phone assembly industry. This method focuses on process visualization, waste reduction, and workflow optimization. By creating a detailed flowchart of the entire production process, VSM enables a comprehensive understanding of each step, making it easier to identify inefficiencies and areas requiring improvement. One of VSM's primary advantages is its ability to provide decision-makers with a clear roadmap for cost reduction and process enhancement. This approach improves overall efficiency by eliminating non-value-adding activities, streamlining workflows, and ensuring optimal resource utilization. Beyond operational benefits, VSM also enhances product quality and customer satisfaction by fostering a more structured and responsive production environment. Implementing VSM results in a more efficient manufacturing process, as each stage is thoroughly analyzed to eliminate unnecessary delays and waste. Reducing production time and costs leads to a more agile and competitive business model. Identifying and addressing bottlenecks also allows for proactive problem-solving, ensuring a smoother workflow. In the long run, VSM is a strategic investment that drives profitability, operational excellence, and customer-centric improvements.

KEYWORDS: *Value Stream Mapping, Lean Manufacturing, Process Optimization, Mobile Phone Assembly, Waste*

ICEWS #52

REDUCING FLUORIDE CONTAMINATION IN GROUND WATER SAMPLES OF UMERKOT SINDH USING ELECTROCHEMICAL TECHNIQUE

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ABSTRACT:

This study investigates the efficacy of an electrochemical process utilizing aluminum electrodes to remove fluoride from groundwater samples collected from Umarkot District, Sindh. Excessive fluoride levels in drinking water pose serious health risks, including dental and skeletal fluorosis, with prolonged exposure potentially leading to joint pain, bone deformities, and neurological issues. Three water samples were collected from different locations with initial fluoride concentrations of 10.5 mg/L, 11 mg/L, and 15.4 mg/L, and pH levels of 7.6, 7.8, and 8.1, respectively. The electrochemical treatment was conducted in a 1-liter beaker using a two-electrode configuration. The process was operated at two different current densities, 0.04 A/cm² and 0.05 A/cm², for a duration of 30 minutes. At a current density of 0.04 A/cm², fluoride removal efficiencies were 95.04%, 96%, and 94% for Samples 1, 2, and 3, respectively. At a higher current density of 0.05 A/cm², removal efficiencies increased to 95.6%, 96.8%, and 95.3% for the respective samples. These findings indicate that the electrochemical process with aluminum electrodes is a viable method for the effective removal of fluoride from contaminated groundwater sources, reducing potential health risks for rural communities.

KEYWORDS: *Electrochemical Treatment, Electrode, Fluoride Removal, Ground Water, Health*

ICEWS #54

APPLICATION OF TOTAL PRODUCTIVE MAINTENANCE IN TEXTILE INDUSTRY TO IMPROVE OVERALL EQUIPMENT EFFECTIVENESS: A CASE STUDY

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ABSTRACT:
Al Rahim Textile Industry Ltd. faces significant maintenance challenges that are impacting machine efficiency, production quality and cost-effectiveness. In Al-Rahim Textile Industry, the absence of a standardized maintenance system, poor inventory visibility, inefficient utilization of maintenance resources and underutilization of breakdown data have resulted in increased downtime and reduced overall equipment effectiveness (OEE). The key aspect of this research is the implementation of Total Productive Maintenance (TPM), integrating core pillars aligned with structured project activities to overcome the problems. The study begins with data collection and failure analysis, breakdown data validation, production output tracking, and quality inspection records. Analytical techniques such as Root Cause Analysis (RCA), Pareto Analysis, and Fishbone Diagrams are applied to identify key problem areas affecting machine performance. The mean time between failures (MTBF) was identified to schedule preventive maintenance. To improve inventory management, spare parts cost analysis and minimum quantity level assessment are conducted, ensuring optimized stock levels and reducing downtime due to part shortages.
KEYWORDS: *Total Productive Maintenance, Overall Equipment Effectiveness, Performance Improvement*

ICEWS #57

HYDRO-BIOGEOCHEMICAL CHANGES IN CANDIDATE DEPLETED GAS WELLS AND SALT CAVERN WELLS: IMPLICATION FOR HYDROGEN STORAGE

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ABSTRACT:
Hydrogen energy has potential to minimize CO_2 emissions and prevent the effect of global warming. This study examines the biotic and abiotic processes influencing underground hydrogen storage in the Perth and Canning Basins, emphasizing microbial growth dynamics and mineral interactions. Our results reveal that hydrogen concentration significantly affects microbial activity, with optimal growth occurring between 15-25 wt%. Both lower and higher concentrations inhibit microbial proliferation, indicating a time-dependent relationship that warrants further investigation. Additionally, sulfide concentrations increased across experimental conditions, suggesting that hydrogen concentration may influence sulfide production rates. Hydrogen losses were observed in geological settings, driven by microbial and abiotic reactions, with methane generation resulting from the interaction of hydrogen and carbon dioxide. The presence of sulfate-bearing minerals, such as pyrite and barite, plays a crucial role in hydrogen sulfide (H_2S) generation through biotic and abiotic pathways. Mineral dissolution and precipitation analyses demonstrated variability in the Canning and Perth Basins, with feldspars, calcite, and quartz consistently dissolving while pyrite, illite, and kaolinite precipitated. This mineral precipitation presents operational challenges in hydrogen storage, potentially reducing rock permeability and hindering injection and production cycles. Future research should focus on the role of bacterial consortia in uniform salt cavern conditions to assess the long-term viability of hydrogen storage solutions in these geological formations.

KEYWORDS: *Hydrogen Energy, Energy Transition, Geological Storage, Salt Cavern, Perth Basin, Canning Basin*

ICEWS #58

GEOPHYSICAL RESISTIVITY SURVEY FOR THE EXPLORATION OF GROUND WATER STATUS OF SMALL DAMS AT NAGARPARKAR

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ABSTRACT:
This study examines groundwater near Nagarparkar small dams, assessing their impact on water levels, recharge and socio economic impacts. It aims to develop sustainable aquifer management strategies. Four small dams got aquifer samples and a geophysical resistivity survey. Groundwater quality data were gathered along dams, and underlying resistivity surveys were conducted to depth of 100(300ft) meters. This study assesses the impact of small dams on groundwater, land cover, and socio-economic conditions in Nagarparkar, along with current and future water demand. To identify and define the aquifer systems, groundwater recharge, aquifer depth, groundwater quality, and subsurface lithology of aquifers, the primary goal of this research is to conduct a hydrogeology, hydrology, and geophysical investigation respectively. At Sehriyoon Dam, an aquifer approximately 1.36 meters thick was delineated at a depth of 1.36 meters to 100 meters. The aquifer at Nim aaro is 4.08 meters thick and is delineated from 4.08meters to 100 meters below the surface. The Vikasar Dam is 1.24 meters thick and is marked off up to 1.24 to 100 meters. Gordharo-2 is 10.1 meters thick and is delineated from 10.1 to 100 meters. High salinity, high EC, TDS, Sulphate and hardness, potassium, nickel, iron, and selenium are among the water quality parameters of Sehriyoon Dam. Nim aaro dam having High Chloride and Fluoride, High Potassium, Nickel and Iron. Vikasar having High EC, TDS, Hardness, Chloride and Fluoride possess water quality High Magnesium, Sodium, Potassium, Arsenic, Nickel, Cobalt, Iron and Selenium.Gordharo-2 Dam having High Hardness, Chloride and Fluoride, High Nickel, Iron, and Selenium. The analysis of the data it is observed that the replenishing groundwater aquifers up to the depth 10-30 meters. The water quality surrounding the Sehriyoon, Nimaro, Gordharo, and Vikasar were found suitable for irrigation uses only. In some areas of Sehriyoon and Vikasar have suitable quality of drinking water while the other areas in that locality have high contamination level.

KEYWORDS: *Ground Water, Contamination Level, Water Quality, Geophysical Resistivity Surve*

ICEWS #61

INVESTIGATION OF SALINE WATER INTERACTION WITH HYDROCARBON-POROUS-SYSTEM FOR IMPROVED OIL RECOVERY AND CO_2/H_2 UNDERGROUND STORAGE IN A SANDSTONE ROCK-SAMPLE

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ABSTRACT:

Saline water concentration has a profound effect on fluid-rock interactions which affect Enhanced Oil Recovery (EOR) by means of wettability alteration and interfacial tension (IFT) reduction. This study investigates the sensitivity of a sandstone rock-sample from the Southern Indus Basin to different saline concentrations with an emphasis on spontaneous imbibition behavior and residual oil displacement. Laboratory tests such as X-ray diffraction (XRD), contact angle, pendant drop interfacial tension (IFT) analysis and imbibition tests indicate that saline water at 1000 ppm efficiently converts sandstone from oil-wet to water-wet, enhancing oil recovery by 14.1%. The IFT reduction also improves oil displacement, which is an indication of the effectiveness of low-salinity water (LSW) flooding as a viable EOR technique in a sandstone reservoir. In addition to its EOR uses, this research also examines the possibility of CO_2 and H_2 underground storage in the same geologic environment. LSW flood-altered depleted reservoirs have suitable porosity (~6.7%) and permeability (~0.02 Darcy) which are amenable to CO_2 sequestration and H_2 long-term trapping. The formations are also compatible with international storage projects, especially sandstone reservoirs, where underground storage injection is favored by stable pore structures and capillary retention mechanisms. By showcasing the dual functionality of these reservoirs, this research offers valuable insights into sustainable energy storage solutions and the evolving role of subsurface formations in energy transition strategies.

KEYWORDS: *Improved Oil Recovery, Low-Salinity Water Interaction, Wettability Alteration, CO_2 Geologic Storage, H_2 Underground Storage, Energy Transition*

ICEWS #65

THE EFFECT OF CLAY MINERAL ON CO2 ADSORPTION AND DIFFUSION IN SHALE FORMATION

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ABSTRACT:

The role of minerals, specifically clay in storage of CO2 and transportation is very crucial for optimizing CO2 sequestration in shale reservoirs. Shale rock often work as cap rock for storing CO2 due to its ultra-low porosity and permeability. It contains clay minerals like smectite, kaolinite and illite those influence the adsorption and diffusion behavior of CO2 due to high surface area and cation exchange capacity. This study investigates the adsorption and diffusion behavior of CO2 at Kati and Pokok, Malaysian shale formations via physical adsorption mechanism. Characterization of samples were performed using TOC analysis and XRD, while modified gas diffusion system was used for volumetric adsorption calculation and diffusion at 40 0C and 80 bar. Pressure decay was used to determine the diffusion behavior and Fick model was used to determine the diffusion coefficient. The results show the strong correlation between clay and adsorption, clay and diffusivity, and these findings offer insights shale reservoir CO2 sequestration potential for long term.

KEYWORDS: *CO_2 Sequestration, Shale Reservoirs, Clay Minerals, Adsorption, Diffusion Coefficient*

ICEWS #68

FAILURE MODE AND EFFECT ANALYSIS OF SAFETY VALVE FOR THE HIGH-PRESSURE BOILER (GEKA KONUS)

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ABSTRACT:

Failure mode and effect analysis (FMEA) is a reliability tool that depicts how equipment can fail to perform its intended functions within a specified period under stated conditions. With the emergence of reliability engineering, FMEA defines the root cause of failures and assesses the components' risk priority number (RPN). This study is conducted on High Pressure (H.P) Boiler (Gekakonus) model S 270 which is installed in Faisalabad Oil Refinery (Kisan Edible Oil) at Port Qasim Karachi. H.P. Boiler is the critical component used to raise edible oil temperature from 210 ℃ to 245℃. So, the safety valve is a critical component for the H.P Boiler (Geka konous) to release excessive pressure as the H.P Boiler reaches up to 95 bar**.** However, H.P Boiler control parameters are configured in such a way that the H.P Boiler burner will be cut off at 50±2 bars. If the H.P. Boiler does not cut the burner to the required set value of 50±2, and the H.P. Boiler continues to raise steam pressure to 95 bar, it may lead to serious consequences. Hence, FMEA is a reliability tool through which organizations can minimize maintenance costs by frequently reducing potential errors that have occurred during the operation of the H.P. boiler. This study aims to identify potential failures in the safety valve of the H.P. Boiler in the edible oil sector. So, by adopting FMEA practices on safety valves for the H.P. Boiler, an organization could save assets from any hazards in the future.

KEYWORDS: *Reliability Engineering, Failure Mode and Effect Analysis, Risk Priority Number, Safety valve, High-Pressure Boiler*

ICEWS #71

USE OF WATER QUALITY INDEX AND GIS FOR ASSESSING AND MAPPING THE GROUNDWATER QUALITY OF TALUKA KOTDIJI, SINDH, PAKISTAN

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ABSTRACT:

Groundwater is a crucial natural resource that supports human life, agriculture, and ecosystems. Groundwater is broadly consumed around the globe including in Taluka Kotdiji, Sindh, Pakistan for drinking and irrigation purposes. Taking into consideration the issues of civil society of Taluka Kotdiji, Sindh about groundwater vulnerability, the research was carried out to estimate and delineate the quality of groundwater based on the application of water quality index (WQI) and ArcGIS software. Analysis based on the WQI model, no water sample was in the excellent category, however, 64.1%, 28.2%, 5.1% and 2.6% of the samples fall in good, poor, very poor and unsuitable for drinking categories. The GIS maps depicted that water quality on the South-Eastern side of the study area is vulnerable. Overall, the study found that the water quality in a number of areas of taluka Kotdiji does not meet WHO standards. It needs to be thoroughly filtered before drinking. To raise public awareness of groundwater vulnerability and its impact on health, a campaign should be launched with community and school students to understand the importance of water quality.

KEYWORDS: *Groundwater Vulnerability, Physicochemical Parameters, WHO, WQI, Thematic Maps*

ICEWS #74

A SPATIAL MAPPING FOR ARSENIC (AS) CONCENTRATION HOTSPOTS TOWARDS GENERATING WATER QUALITY PROFILE & DEVELOPMENT OF SUSTAINABLE PROTOTYPE WATER TREATMENT SYSTEM FOR LARKANA

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ABSTRACT:

Arsenic contamination of groundwater is a significant environmental and public health concern for localities dependent on for drinking. Larkana is reported to have higher arsenic concentration, posing health risks, necessitating further investigation into the patterns of contamination and possible remediation strategies. This study aimed to assess post-flood drinking groundwater quality, identify arsenic hotspots in groundwater distribution, and assess a low-cost prototype treatment strategy for arsenic removal. A total of 112 groundwater samples were strategically collected from urban and peri-urban settings by grid sampling (n=112). A systematic assessment of physicochemical parameters and microbiological parameters was completed, which included pH, turbidity, electrical conductivity, total dissolved solids, hardness, major ions, microbial counts, and arsenic concentrations, following ASTM and APHA standards. A spatial assessment of arsenic concentrations in drinking groundwater using GIS base IDW interpolation and Getis-Ord Gi* hotspot mapping indicates spatial differences in the occurrence of elevated concentrations of arsenic above WHO guidelines of 10 ppb. Correlation analysis indicated statistically significant negative relationship between arsenic - electrical conductivity and arsenic - total dissolved solids ($p < 0.05$), indicating that geochemical processes related to solids control arsenic mobility. A pilot low-cost water treatment system design was tested that achieved 90-96% removal efficiencies for arsenic, plus ions associated with detrimental health effects, could be reduced to acceptable levels. This study demonstrates the need for continued monitoring of aquifers affected by arsenic, ongoing mitigation strategies, and development of decentralized treatment systems for protection of drinking water supplies and public health in affected regions of the world.

KEYWORDS: *Arsenic Contamination, Groundwater Quality, GIS Spatial Analysis, Water Quality Index, Decentralized Treatment.*

ICEWS #76

A REVIEW ON BEHAVIOUR OF PERFOBOND LEISTEN (PBL) SHEAR CONNECTORS IN UHPC

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ABSTRACT:

Ultra-High-Performance Concrete (UHPC) has become a revolutionary material in the construction industry because of its remarkable mechanical qualities and longevity. Perfobond Leisten (PBL) connectors are integral components in composite construction, facilitating efficient load transfer between concrete elements and steel structures. The main objective of this mini review is to analyze PBL connectors' mechanical performance, structural efficiency, and design concerns with UHPC. This review clarifies the important significance of PBL shear connections in improving the structural integrity and performance of UHPC composite structures by a thorough assessment of the literature. It has been concluded that the PBL connector behavior in UHPC systems is affected by elements including connector geometry such as the whole diameter, rebar diameter, and material qualities like the compressive strength and yielding strength of steel.

KEYWORDS: *UHPC, PBL Shear Connectors, Mechanical Performance, Rebar Size, Pushout Test.*

ICEWS #81

QUANTIFYING THE INFLUENCE OF SHALE PROPERTIES ON CO_2 ADSORPTION USING STATISTICAL APPROACHES

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ABSTRACT:

For optimization of geological storage of CO2, it is essential to understand the correlation between the shale properties and adsorption. This study focuses on the characterization of Eagle ford and Marcellus shale formation and investigates the relation between Elemental composition, total organic content (TOC), pore structure and CO2 adsorption. Statistical analysis that includes Pearson correlation, heatmap visualization and principal component analysis (PCA) were employed to analysis the influence of pore volume, surface area, TOC and elemental content on adsorption capacity. The findings of this study highlight that carbon, pore volume and surface area have strong positive correlation with adsorption, while some minerals like carbonates have negative correlation. These findings provide important insights into selection of optimal shale formation for CO2 sequestration.

KEYWORDS: *CO_2 Sequestration, Adsorption, Shale, Correlation Analysis, Principal Component Analysis*

ICEWS #82

EVALUATION OF PHYSICOCHEMICAL PROPERTIES OF TREATED EFFLUENT FROM A TEXTILE INDUSTRY'S WASTEWATER RECYCLING PLANT: A CASE STUDY

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ABSTRACT:
Water scarcity is a pressing global issue, and Pakistan is among the nations grappling with this challenge. Consequently, the utilization of wastewater and unconventional water sources has gained significance for irrigation and environmental preservation. Pakistan's industrial sector discharges massive volumes of untreated wastewater into sewage systems, necessitating treatment plants for effective use. The textile industry, a major contributor, releases pollutants like salts, surfactants, heavy metals, organic toxins, and biocides through its operations. In an effort to address water scarcity and pollution stemming from wastewater discharge, a textile industry has implemented a wastewater recycling plant. This study evaluates the physicochemical properties of treated wastewater and subsequently compares them with Punjab Environmental Quality Standards (PEQS). Samples were collected from various treatment facility points for onsite and laboratory assessments, analyzing Biological Oxygen Demand (BOD5), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), temperature, and pH levels. Comparing the experimental results with PEQS benchmarks revealed BOD5 (27mg/L), COD (50mg/L), TSS (20mg/L), TDS (2592mg/L), DO (2.1mg/L), temperature (31°C), and pH (8), all within PEQS thresholds of BOD5 <150mg/L, COD <300mg/L, TSS <200mg/L, TDS <3500mg/L, DO >2.0mg/L, temperature <40°C, and pH levels ranging from 6.5 to 9. The reclaimed water is used for gardening, but further treatment, particularly through a tertiary treatment process, is essential for safe groundwater injection. Hence, a future feasibility study could explore the potential implementation of a Reverse Osmosis (RO) plant to enhance the treatment of wastewater, ensuring its suitability for wide range of applications.

KEYWORDS: *Water Scarcity, Wastewater Treatment, Textile Industry, Environmental Standards, Water Quality Assessment, Punjab Environmental Quality Standards (PEQS), Reverse Osmosis (RO) Feasibility*

ICEWS #83

PUSHOVER ANALYSIS ON SHEAR WALL IN HIGH-RISE BUILDING CONSIDERING HORIZONTAL AND VERTICALLY CONFIGURATIONS

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ABSTRACT:
Shear walls are crucial structural components that enhance the lateral load resistance of high-rise buildings, particularly in seismic-prone regions. This study explores the influence of shear wall placement on the seismic performance of an L-shaped high-rise building through nonlinear pushover analysis in ETABS. Various shear wall configurations are examined to assess their impact on critical structural parameters, including base shear capacity, lateral displacement, and overall stability. The analysis is conducted following ACI-318, FEMA-356 and ATC-40 guidelines to ensure accuracy in performance evaluation. By comparing different shear wall arrangements, the study identifies optimal configurations that improve seismic resilience while maintaining structural efficiency. The findings contribute to advancing performance-based seismic design approaches, offering valuable insights for engineers and designers to enhance the safety of high-rise structures.

KEYWORDS: *Shear Walls, L-shaped High-rise Building, Nonlinear Pushover Analysis, Seismic Performance, ETABS, Base Shear Capacity, Lateral Displacement, Structural Stability, ACI-318, FEMA-356, ATC-40, Performance-based Seismic Design*

ICEWS #84

ENHANCED OIL RECOVERY AND GEOTHERMAL ENERGY UTILIZATION FROM HEAVY OIL RESERVOIRS: A SUSTAINABLE APPROACH

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ABSTRACT:
Large amounts of heavy oil contain by reservoir are not possible to extract via simple primary and secondary production methods due to high viscosity and low mobility. The enhanced Oil recovery (EOR) method should be adopted to solve this problem. This research investigates the feasibility of using steam injection techniques for both EOR and geothermal energy production. Simulation was performed using Eclipse 300 model to evaluate the effectiveness of cyclic steam simulation and flooding for improving the recovery of oil and harnessing geothermal energy. Study also performed sensitivity analysis on key parameters of reservoir that include injection rate, reservoir thickness, porosity and permeability to check their impact on oil recovery and heat transfer. The study depicts that this flooding technique increases oil production and provides geothermal energy for power production. Findings of this research highlight that optimized steam injection can receive a recovery factor of 50% to the original oil in place (OOIP) parallel maintaining sustainable energy production. These findings support the dual application of heavy oil reservoir for hydrocarbon recovery and energy utilization in form of renewable energy and provide a viable solution to energy security and sustainability challenges.

KEYWORDS: *Heavy Oil Recovery, Steam Injection, Enhanced Oil Recovery (EOR), Geothermal Energy, Reservoir Simulation*

ICEWS #85

COMPARATIVE ANALYSIS ON DIFFERENT TYPES OF SOLAR STILL: A REVIEW

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ABSTRACT:
Access to clean drinking water is essential for public health and well-being. However, with the growing global population, the demand for clean water and the extraction of freshwater for life-sustaining purposes have intensified, making water availability and conservation a critical challenge. The World Resources Institute (WRI) has identified 17 countries, including Pakistan, facing an extremely high-water crisis. More than 22.1 million Pakistanis do not have access to clean drinking water. To address fresh drinking water shortage issues, various strategies have been explored, solar distillation, utilizing solar stills, is emerging as a leading solution to address global drinking water scarcity. This review examines different types of solar stills based on design, construction, working mechanism, efficiency, clean water production, and cost-effectiveness. The analysis highlights that solar stills demonstrate superior performance in meeting water purification needs. Furthermore, the integration of Phase Change Materials (PCMs) and hybrid solar stills has been 77% effective for enhancing distillation efficiency. Findings also reveal the substantial environmental benefits of solar desalination, which can reduce the carbon footprint of water production by up to 70%, aligning with the United Nations Sustainable Development Goals (SDGs) related to clean water access and climate action.

KEYWORDS: *Solar Distillation, Clean Drinking Water, Water Scarcity, Phase Change Materials (PCMs), Sustainable Desalination*

ICEWS #89

GIS AND RS-BASED THEORETICAL ANALYSIS OF RAINWATER HARVESTING POTENTIAL IN KARACHI CITY

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ABSTRACT:
Rainwater harvesting (RWH) is one of the oldest conservation techniques. RWH is the collection and storage of rainwater that runoff from rooftops, parks, roads, and open grounds. This strategy not only tackles the problem of flooding that results from heavy rainfall in urbanized cities but can also fulfil the water demand of the city to some extent. The current climate change scenario has also put stress on the natural water resources, which are depleting rapidly. This study's goal is to find out the rainwater harvesting potential for Karachi city. Esri land use land cover (LULC) classification map 2021 and the average annual rainfall record were used to find the potential of rainwater harvesting. The buildup area for Karachi city was calculated in ArcMap using a geometry dialogue box. The estimated potential was found to be 73000 hectares of land. The annual average rainfall record in Karachi city was found to be 174mm, hence it was estimated that the 73000 hectares of land can store 127 million cubic meters (m^3) of rainfall annually by raising the water depth to 174mm over the area which can account for 17% of water deficiency for Karachi city. Theoretically, it is concluded that rainwater harvesting will help Karachi satisfy its water needs while also reducing the risk of flooding. Based on the outcome of this study, it is suggested that the strategy of rainwater harvesting for metropolitan cities like Karachi is very appropriate to tackle the current climate change challenges, especially in water-stressed countries like Pakistan.

KEYWORDS: *Rainwater Harvesting, ArcMap, Climate Change, Karachi, land Use Land Cover (LULC)*

ICEWS ID # 90

INTELLIGENT COMPUTING APPROACH FOR SECOND GRADE FLUID FLOW

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ABSTRACT:
Recurrent Neural Networks consist of interconnected neurons with at least one recurrent connection, having the ability to learn intricate patterns and long term dependencies. This research study aims to explore the flow of second grade fluid with the help of Recurrent Neural Networks back propagated with Levenberg-Marquardt Algorithm. Flow is generated due to temperature gradient. Heat transfer in the fluid flow is studied. The impact of different physical parameters such as Prandtl number Pr, Second grade fluid parameter β, and Eckert number Ec is upon velocity and temperature profile is deciphered. The dataset for variation of these parameters is obtained by state of art Adams Numerical Method which is then used for training RNN in MATLAB Software. After maximum number of epochs, Mean Squared Error MSE of order 10^{-12} and R squared value 1 obtained exhibiting the ideal curve fitting. The regression plots, error distribution plots, correlation plots depict the cutting edge ability of RNN to learn from data. Moreover, the velocity profile upsurges for second grade fluid parameter. The temperature profile also exhibits the increasing behavior for second grade fluid parameter β. The primary results of this research could find use in a number of domains, such as electronic device cooling and polymer processing, particularly in the areas of electronic coolant system design and optimization.

KEYWORDS: *Recurrent Neural Networks, Second Grade Fluid, Adams Numerical Method, Levenberg-Marquardt Algorithm, Optimization*

ICEWS ID #91

ENHANCING SOLAR DESALINATION EFFICIENCY USING A FRESNEL LENS: A SUSTAINABLE APPROACH TO WATER PRODUCTION

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ABSTRACT:

The demand for potable water is increasing due to population growth, industrialization, agriculture, and climate change, leading to water scarcity and pollution. Solar desalination is a sustainable solution to produce freshwater, particularly in regions with high solar energy availability. However, conventional solar has low efficiency and produces limited water. This study investigates the integration of a Fresnel lens into a single-basin, single-slope solar still to enhance heat input and improve desalination performance. The aim of this study is to purify saline water using solar energy and improve water production by incorporating a Fresnel lens to enhance solar concentration and heat transfer efficiency Experiments were conducted under controlled conditions to compare the performance of solar with and without the Fresnel lens. The results show that under a global radiation of 6.2 kWh/m², the solar still with the Fresnel lens produced 390 ml of distilled water per 0.348 m² in 10 hours, while the conventional still produced only 250 ml respectively. Experimental results confirm that the modified solar still produces a higher distillate yield compared to the conventional design. The observed improvement of approximately 140 ml demonstrates the effectiveness of the Fresnel lens in boosting water production. This study highlights the potential of optical enhancement techniques to improve solar desalination efficiency, making it a more viable solution for addressing water scarcity in regions with abundant solar energy. Therefore, the use of a Fresnel lens exhibits a promising approach to increasing freshwater yield, making solar desalination a more practical and scalable solution for water-scarce regions.

KEYWORDS: *Solar Desalination, Fresnel Lens, Water Purification, Heat Transfer Enhancement*

ICEWS #92

IOT-BASED SMART IRRIGATION SYSTEM TO REDUCE WATER SCARCITY AND CROP YIELD ENHANCEMENT

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ABSTRACT:
This paper specially focuses on water scarcity which is pressing issue of today's world so to reduce water consumption and food production, we need to implement some smart solutions like the creation of effective and sustainable irrigation system is required due to growing for food productions around us, water scarcity, and climate change. In order to achieve required design for better results, this study proposes an Internet of Things (IoT) smart irrigation system that makes use of crop water stress indicators, weather forecasts, and real-time soil moisture sensors. Significant water savings and increased crop yields are the results of the suggested system's integration of machine learning algorithms to forecast crop water requirements and modify irrigation accordingly. When compared to conventional irrigation techniques, field tests on a 10-acre farm show that the smart irrigation system increases crop yields by 25% while consuming 30% less water. This innovative approach will revolutionize the agriculture and reduce water consumption.
KEYWORDS: *Smart Irrigation, Sustainable Irrigation, IoT, Algorithms, Conventional Irrigation*

ICEWS #93

WATER CONSUMPTION AND WASTEWATER GENERATION IN HYDERABAD: A POTENTIAL FOR WATER CIRCULAR ECONOMY

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ABSTRACT:

Water scarcity and wastewater management are pressing challenges in rapidly urbanizing cities like Hyderabad, which has a total water supply of approximately 60 Million Gallons per Day (MGD). This research examines water consumption and wastewater generation patterns in the city, a focus on key water quality parameters with average results such as Biochemical Oxygen Demand BOD (170 ppm), Chemical Oxygen Demand COD (260 ppm), Total Organic Carbon TOC (14 ppm), and Total Dissolved Solids TDS (1200 ppm). The surveyed population of Hyderabad, approximately 2.2 million residents, consumes an estimated 200 million gallons of water per day. Moreover, residential water use, specific sectors such as car wash service stations and nurseries contribute significantly to the city's water demand. The 64 car wash service stations use around 0.4 to 0.7 million liters of water per day, while 48 nurseries consume between 0.34 and 0.68 million liters per day. The total wastewater generated in the city ranges from 330 to 440 million liters per day, most of which is either directly or indirectly disposed of into the Indus River. GIS maps were created to illustrate the distribution of water consumption and wastewater generation across various locations, including sampling points, car wash stations, and nurseries. The study highlights the potential for adopting a water circular economy approach in Hyderabad. By promoting wastewater reuse and resource recovery, the city could significantly reduce its reliance on freshwater, alleviate the environmental burden, and improve overall water management. This study suggests sustainable strategies that not only improve water conservation but also contribute to the long-term sustainability of the city's water resources.

KEYWORDS: *Water Consumption, Wastewater Generation, Water Management, Water Circular Economy*

ICEWS #97

ASSESSMENT OF PHYSICOCHEMICAL PARAMETERS OF QUALITY OF DRINKING WATER SUPPLIED NIMAISH AREA OF SUKKUR SINDH AND ITS REMEDIAL MEASURES

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ABSTRACT:

The aim of this effort to assess the water quality supplied nimaish area of Sukkur City in terms of physicochemical parameters from Indus River as well as NWC from Indus River as well as NWC. For this purpose in all 12 samples were collected from 04 different locations (04 sample were collected from each location (1. Source Indus River:- One sample from upstream, downstream, bander road pumping station point & one sample from NWC pumping station point, 2.Bander Road WTP:- One sample from inlet, outlet and 02 samples from different end users, 3. Nimaish WTP: - One sample inlet, outlet and 02 samples from different end users. 12 different physicochemical of all saples of water were assessed. Results were compared with national and international standards (WHO standards). Results revealed that color of water was muddy/turbid of all sample, excluding samples nimaish WTP, while odor is unobjectionable in all samples. However turbidity was too high at all locations excluding outlet and end users of nimaish WTP, which indicates that water supplied to nimaish road area of Sukkur Sindh. is not suitable for human consumption. It is concluded that poor supervision, poor water treatment and un-proper disinfection treatment is the chief cause of bacterial contamination of surface water supplied to Nimaish area of Sukkur City from Indus River/NWC. Most common reasons of contamination such like no proper treatment, poor, old and unsecured water pipe lines overlap with the damaged sewage and drainage lines. To supply safe drinking water to Sukkur city following suggestion should be considered to make treatments plants (at Bunder Road WTP, nimaish WTP) functional as well as enhance the capacity of treatment plants as per demand. Periodic cleaning of all distribution ponds, old water supply lines must be replaced with new lines especially of those lines which are close to waste water lines. Proper chlorination in distribution ponds proper retention time, waste water lines and water supply lines should be keep away from each other. Waste water must be treated before disposed of in Indus River & NWC & All those waste water lines should be removed which are in upstream of pumping stations. Creation of awareness among the employees of water supply agency and general public about the importance of drinkable water and consequences of unsafe water and the appointment of qualified staff.

KEYWORDS: *Assessment of Drinking Water Quality, Physicochemical, Nimaish area of Sukkur, Not suitable*

ICEWS #99

ASSESSMENT OF CHEMICAL PROPERTIES OF GROUND WATER QUALITY OF LARKANA CITY

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ABSTRACT:

Groundwater is the most important source of drinking water in Sindh Province of Pakistan. However, the quality of this crucial element of life is deteriorating day by day throughout Pakistan particularly in its Sindh province. Thus the study was carried out to determine the chemical contamination in the groundwater of the Larkana city of Sindh province. Total 40 samples were collected randomly from various locations of Larkana city. The chemical parameters like pH, Calcium, Magnesium, Total hardness (TH), Arsenic, Chloride, Sodium, Iron, Nitrites, and Nitrates were determined in the laboratory and were compared with WHO permissible limits. The results revealed that 26% of samples were having chloride beyond permissible limit; 32% samples were having concentration of Total Hardness (TH) above the desirable limits. Moreover, 6%, 23%, 29%, 92%, 80%, of samples had concentration of Nitrates, Nitrites, Sulfate, calcium, and magnesium respectively beyond the permissible limit. However, the concentration pH, Iron, Sodium, and Arsenic in groundwater found within the permissible limit.

KEYWORDS: *Permissible limit; Assessment, Chemical Properties of Groundwater Quality, Larkana*

ICEWS #101

OPTIMIZING ENHANCED OIL RECOVERY WITH NANOPARTICLES: THE INFLUENCE OF SILICA (SiO_2) AND MAGNESIUM OXIDE (MGO) ON RESERVOIR CHARACTERISTICS

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ABSTRACT:
This research explores the potential of nanoparticle-assisted enhanced oil recovery (EOR) as an innovative approach to overcoming the limitations of conventional oil extraction methods. Traditional primary and secondary recovery techniques typically recover only 20% to 40% of the original oil in place, leaving a significant portion of the reserves untapped. In contrast, nanoparticles offer a promising alternative by modifying key reservoir properties such as permeability, wettability, and interfacial tension (IFT), leading to improved oil displacement efficiency The sandstone core was saturated with crude oil and subjected to sequential flooding stages: baseline water flooding (primary recovery) followed by nanofluid injection (0.01–0.1 wt% concentration) and post-flush brine. Interfacial tension (IFT) reduction, wettability alteration, and displacement efficiency were quantified using a contact angle measurement, and recovery factor calculations. Results demonstrated that SiO_2 nanoparticles achieved a 12.6% incremental oil recovery compared to conventional water flooding, attributed to IFT reduction (from 18.5 mN/m to 9.2 mN/m) and a 34° shift toward water-wet conditions. MgO nanoparticles show moderate recovery enhancement (7.4%) via wettability modification, likely due to surface charge interactions and adsorption on sandstone. Synergistic effects were observed in hybrid nanofluids (MgO-SiO_2), yielding a 15.3% recovery boost but requiring salinity-dependent stabilization. Post-experiment confirmed nanoparticle retention in pore throats without significant permeability impairment (<8% reduction). This work highlights the potential of tailored nanofluid formulations for sandstone EOR while emphasizing the critical role of dispersion stability under high-salinity conditions. Optimal performance was enhanced at 0.050 wt% SiO_2, underscoring its viability for field applications.

KEYWORDS: *Nanoparticles, Wettability, Permeability, Interfacial Tension, Core Flooding, Fluid Flow*

ICEWS #102

MODELING THE ROLE OF SUBMERGED COASTAL VEGETATION IN MITIGATING TSUNAMI AND FLOOD CURRENTS

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ABSTRACT:

This research uses Computational Fluid Dynamics (CFD) with the Volume of Fluid (VOF) technique to model the role of submerged coastal vegetation in reducing tsunami and flood currents. While most studies focus on river systems, this work addresses the gap in tsunami-related research. By simulating varying conditions such as wave height, water depth, and flow velocity, the study examines how submerged vegetation affects the intensity of tsunami and flood waves. The findings will provide insights into nature-based solutions for coastal protection, contributing to improved strategies for mitigating the impact of extreme wave events and enhancing coastal resilience.

KEYWORDS: *Tsunami, CFD, VOF, Energy Dissipation, Submerged Vegetation*

ICEWS #106

EOR-CCS POTENTIAL OF PAKISTAN IN MITIGATING RISING GHG EMISSIONS

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ABSTRACT:
Pakistan`s greenhouse gas (GHG) emissions share is increasing annually with CO_2 emissions exceeding 223 million metric tons (MT) in 2021, primarily driven by fossil fuel consumption in power generation, industry, and transportation. Coal, oil, and gas play major roles in the nation's energy sector, accounting for more than 46% of total emissions. As Pakistan faces rising energy demand and climate commitments under the Paris Agreement, Enhanced Oil Recovery with Carbon Capture and Storage (EOR-CCS) emerges as a promising solution to reduce emissions while improving domestic oil recovery. Pakistan's geological formations, particularly in the Indus Basin, offer an estimated 8–16 gigatons (GT) of CO_2 storage capacity in depleted oil and gas reservoirs and deep saline aquifers. The integration of EOR-CCS can help capture and store emissions from major industrial sources such as coal-fired power plants, cement, and fertilizer industries while extending the productivity of mature oil fields. However, challenges such as high capital costs, regulatory gaps, and infrastructure constraints must be addressed for large-scale deployment. This study examines Pakistan's EOR-CCS potential, highlighting economic feasibility, technological advancements, and policy frameworks required for successful implementation. International collaborations, carbon credit incentives, and public-private partnerships can accelerate adoption. By leveraging EOR-CCS, Pakistan can achieve significant emission reductions, enhance energy security, and support a transition toward a low-carbon economy while maximizing its hydrocarbon resources.

KEYWORDS: *Enhanced Oil Recovery (EOR), carbon capture and storage (CCS), Pakistan Energy Sector, GHG emissions, CO_2 Storage Potential*

ICEWS #107

INVESTIGATION ON FLUID FLOW THROUGH SANDSTONE BASED POROUS MEDIA VIA DIGITAL CORE ROCK ON CHIP TECHNIQUE

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ABSTRACT:
This study investigates fluid flow behavior in sandstone formations using a combination of scanning electron microscopy (SEM), micro-CT imaging, and rock-on-chip microfluidic models. The research aims to replicate real sandstone pore structures, enabling direct visualization of single-phase and multiphase flow dynamics under controlled conditions. By incorporating surfactant flooding experiments and computational simulations using CMG software and computational fluid dynamics (CFD), this study evaluates the impact of wettability, mineral heterogeneity, and micro-fractures on fluid displacement efficiency. The methodology involves constructing high-resolution digital core models, fabricating microfluidic chips that simulate sandstone pore networks, and conducting flow experiments using optical microscopy. Additionally, computational modeling techniques such as pore network modeling (PNM) and Lattice Boltzmann simulations are employed to enhance predictive accuracy. The study further explores surfactant-induced emulsification and its implications for pore-scale fluid mobility, assessing the potential for improved chemical EOR applications. The findings from this research contribute significantly to reservoir engineering by providing a comprehensive understanding of fluid transport mechanisms in sandstone reservoirs with 35% pore connectivity. The integration of experimental and computational approaches enhances predictive modeling of reservoir-scale permeability and informs the optimization of fluid injection strategies saturating 70% of void spaces in experimental chip. This study not only advances digital rock physics and microfluidic EOR screening techniques but also provides a cost-effective, scalable, and more accurate method for analyzing complex subsurface fluid interactions. Ultimately, the proposed Digital Core Rock-on-Chip approach offers a transformative method for reservoir characterization, bridging the gap between laboratory-scale experiments and field-scale applications. The insights gained can aid in developing more efficient and sustainable oil recovery strategies, improving the economic and environmental outcomes of hydrocarbon production.

KEYWORDS: *Computational Fluid Dynamics (CFD), Sandstone, Multiphase Flow, Reservoir Characterization*

ICEWS #108

SEAFLOOR STABILITY AND SUBSIDENCE ANALYSIS FOR POST HYDRATE DISSOCIATION ALONG THE COASTAL LINE OF PAKISTAN

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ABSTRACT:

A finite element model is developed considering the characteristics of seafloor at Makran coast. Unfortunately, natural gas hydrates are not explored and produced properly yet because when the fuel from such sources is recovered it leaves back free void spaces which are located under the seafloor. Thus, seafloor stability analysis is required to identify the possibilities of seafloor subsidence. For this purpose, a finite element model is developed to identify and analyze the seafloor stability and subsidence. The model comprises of mechanical properties of the zone and hydrate bearing sediments at the depth of 500 m below the seafloor. The model accuracy is achieved by setting the structural meshes to avail maximum refined outcomes. The result of this study suggests that there are minor chances of seafloor collapse which should be backed by CO2 injection so that aftermaths can be tackled. Moreover, the formation overburden varies from 5 MPa to 7 MPa which is remarkable change but considerable for precautionary measures. Additionally, the formation pressure showed decline of 30% pressure decline which refer to recovery of viable quantity of natural gas from targeted zone. Concludingly, it is recommended that natural gas recovery from gas hydrates found near Makran coast are feasible for gas recovery with reduced geological threats. Although natural gas hydrates considered as the new energy source of 21st century are milky white solid ice-like substances, but it is 20 times denser than natural gas. Fundamentally, natural gas is not soluble in water but due to certain temperature and pressure condition gas molecules get trapped in frozen water and form natural gas hydrates in subsurface. Moreover, it was found that the single cubic meter of natural gas hydrate yielded up to 164 cubic meters of natural gas.

KEYWORDS: *Finite Element Model. Gas Hydrates, Natural Gas Recovery, Seafloor Stabili*

ICEWS #109

A COMPARATIVE STUDY OF VARIOUS NANOPARTICLES IN DEPLETED OIL RESERVOIRS OF LOWER INDUS BASIN USING CMG SIMULATION

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ABSTRACT:

Enhanced oil recovery (EOR) methods are essential for enhancing the recovery from low-permeability and depleted oil reservoirs. A comparative evaluation of different nanoparticles, i.e. silica, iron oxide, and titanium dioxide, is performed to evaluate their potential for EOR in the depleted oil reservoirs of the Lower Indus Basin (LIB). The LIB is characterized by complex reservoir conditions, such as low permeability, high water saturation, and large depletion, and therefore represents a good candidate for EOR methods. The preferred nanoparticles for the investigation are the most widely applied for EOR because of their special characteristics. In order to evaluate the performance of these nanoparticles is assessed through the use of CMG (Computer Modeling Group) simulation software. The CMG simulation model created for the purpose to analyze the injection of fluids assisted with nanoparticles into the depleted reservoirs of LIB. The simulations concentrate on primary performance indicators like oil recovery rates, recovery factor, sweep efficiency, and mobility control. This study also considers the viability of utilizing each nanoparticle, based on material price, synthesis, and efficiency in terms of recovery. The results yield important insights into the efficiency of silica, iron oxide, and titanium dioxide nanoparticles in oil recovery in the LIB's depleted reservoirs. The study also explores the pool of knowledge concerning the application of nanoparticles in EOR. Recommendations are based on the most appropriate nanoparticle for LIB EOR projects based on both performance parameters and economic viability.

KEYWORDS: *Depleted Reservoirs, Lower Indus Basin, Nano-based EOR, EOR Simulation, CMG Simulation*

ICEWS #110

OPTIMIZING DIRECTIONAL DRILLING TRAJECTORIES USING ROTARY STEERABLE SYSTEMS INTEGRATED WITH GRAPHICALLY ENHANCED TOOLS

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ABSTRACT:
This study investigated the integration of Rotary Steerable Systems (RSS) with graphically enhanced tools to optimize directional drilling trajectories and improve operational efficiency. Traditional Controlled Steerable Systems (CSS) suffer from limitations such as decreased rates of penetration (ROP) during sliding intervals, frequent tool face adjustments, and excessive bit wear. In contrast, RSS enables continuous rotation, improving drilling performance. The primary objective of this research was to develop a graphics-driven framework that enhances real-time decision-making, reduces wellbore instability, and minimizes operational costs. The research methodology involved collecting real-time data from RSS and Measurement While Drilling (MWD) tools, designing wellbore profiles, and developing graphical illustration. Data from over 150 drilling operations were analyzed, with machine learning models trained on parameters such as weight on bit (WOB), tool face angles, and formation characteristics. The graphics-based approach led to a 23% increase in ROP, a 17% reduction in overall drilling time, and a 14% decrease in bit wear compared to conventional RSS operations. Additionally, wellbore deviation errors were reduced by 22%, improving trajectory accuracy in complex geological formations. The findings demonstrate that graphically enhanced RSS systems significantly outperform conventional CSS in both efficiency and cost-effectiveness. Real-time data processing allowed for predictive adjustments, optimizing drilling parameters dynamically and mitigating risks such as borehole collapse and tool failures. The integration of graphics into RSS operations not only improves drilling precision but also contributes to sustainable energy extraction by reducing operational downtime and material waste. This research establishes a scalable framework for graphically enhanced directional drilling, providing a blueprint for future advancements in autonomous drilling technologies. The proposed system holds significant potential for geothermal and hydrocarbon drilling applications, ensuring safer, more efficient, and cost-effective resource extraction.

KEYWORDS: *Directional Drilling, Rotary Steerable Systems (RSS), Wellbore Profiles, Rate of Penetration (ROP)*

ICEWS #111

DEEP LEARNING-BASED GROUNDWATER LEVEL FORECASTING IN THE QUETTA SUB-BASIN: TEMPORAL DEPENDENCY APPROACH WITH ARTIFICIAL NEURAL NETWORKS

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ABSTRACT:
Groundwater depletion is a major threat to water security and sustainable development, particularly in semi-arid regions such as the Quetta sub-basin of the Limestone Aquifers. The increasing demand for groundwater, coupled with climate variability, necessitates robust forecasting models to support effective water management policies and planning. This study presents an Artificial Neural Network (ANN)-based approach for predicting future groundwater levels by analyzing past temporal dependencies rather than relying on external climate model simulations. A comprehensive dataset spanning 1990–2020 was utilized, incorporating key hydro-climatic factors such as cumulative precipitation (PREP lag-based groundwater values (e.g., Regional_WL_Lag_6). The ANN model was fine-tuned using hyperparameter optimization, regularization, and dropout techniques to minimize overfitting and capture long-term groundwater dynamics. The optimized ANN model achieved high-performance metrics, including an R^2 of 0.9565, MAE of 1.96m, and RMSE of 2.84m, demonstrating its effectiveness in learning from historical patterns. Future groundwater levels were forecasted solely based on the learned temporal dependencies within the ANN model, without incorporating external climate model projections. This approach ensures that predictions remain grounded in past groundwater behavior, making them directly applicable for policymaking, water resource planning, and sustainable groundwater management strategies. The study provides a robust framework for integrating deep learning techniques into hydrogeological modeling, offering a scalable and adaptable solution for groundwater forecasting in data-scarce regions.

KEYWORDS: *Groundwater Forecasting, Artificial Neural Networks (ANN), Temporal Dependency, Deep Learning, Water Security*

ICEWS #113

THE FINITE ELEMENT ANALYSIS OF BOREHOLE STABILITY IN DRILLING OPERATIONS IN ABNORMAL PRESSURE FORMATIONS

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ABSTRACT:
The stability of boreholes presents a significant problem during oil and gas drilling operations, especially when exploring zones with abnormal pressures. This often results from the loss of integrity of an open-hole portion, its gauge size, and geometry which can lead to wellbore instability, solid particles inflow, and equipment malfunctioning. The control of wellbore instability is very crucial, especially during drilling operations and other activities for the well to function appropriately. In this research, the focus is on the evaluation of borehole instability using FEA techniques and software Abaqus FEA. In this method, the problems are reduced to the more manageable form using approximation techniques known as discretization. This is done so that realistic scenarios can be simulated, and much is known about the deformation of the wellbore under numerous stresses. The results indicate the distribution of radial stress around the well along the true distance path at different depths (i.e., 1000, 2000, and 3000 m). The simulation uses key input parameters which include Poisson's Ratio (0.25-0.35), Youngs Modulus (10-30 GPa), the mud pressure (25-45 MPa), and the pore pressure (20-40 MPa) to model the stress distribution around the wellbore. The analysis shows that radial stress was found to decrease exponentially with increasing distance from the wellbore wall with an approximate 5 MPa stabilization beyond 2.5 times the wellbore radius. A comparative analysis of radial stress against true distance path reveals that wellbore stability is reached when the stress curve is bounded within the operational limits, while the inverse indicates instability. This research study offers a valuable understanding which helps in improving borehole instability predictions and mitigation in abnormal pressure zones which can be useful for the oil and gas industry to improve their drilling processes and risk factors.

KEYWORDS: *Stability, Drilling, Simulation, Pore pressure*

ICEWS #114

AMINO ACID ASSISTED SYNTHESIS OF MOS2 NANOSTRUCTURES FOR HYDROGEN EVOLUTION REACTION

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ABSTRACT:

Recent trend in hydrogen energy production using electrochemical process is increasing due to green energy production. Molybdenum-based nanostructures, especially Sulfides, have been devoted to electrocatalytical materials due to their unique catalytic and electronic properties. The present work is to synthesize MoS2 in the presence of amino acids such as arginine and aspartic acid in varying amounts (25, 50 and 75mg) using hydrothermal methods for enhanced catalytic properties. The prepared nanostructures were examined using physico-chemical techniques including X-ray diffraction (XRD) for analyzing phase purity, Fourier transform infrared spectroscopy (FTIR) for determination of surface functionalities and Scanning electron microscopy (SEM) for analysis of surface morphology of catalyst. The electrochemical investigation was carried out in 0.5 M H2SO4 media for HER activity. The electrochemical performance of arginine assisted MoS2 (ATAR-75) sample shows the lowest overpotential of 495 mV at 10 mA/cm2 as compared to others prepared catalyst. However, aspartic acid assisted MoS2 (ATAS-25) revealed that overpotential is reduced up to a certain level then increase with increasing the content of aspartic acid. Furthermore, ATAR-75 also exhibited larger effective electrochemical active surface area (15.9 mF/cm2) and durability due to the presence of nano features in the structure.

KEYWORDS: *Molybdenum di sulfide, Aspartic Acid, Arginine, Hydrogen Evolution Reaction, Electrochemical Active Surface Area.*

ICEWS #116

ASSESSMENT OF HELICAL SAVONIUS VERTICAL AXIS WIND TURBINE FOR POWERING STREET LIGHTS IN KHAIRPUR MIR'S

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ABSTRACT:
An assessment of a helical Savonius rotor for powering streetlights was attempted to replace the current photovoltaic-based streetlights in the Khairpur Mir's, Sindh, Pakistan. A major challenge with solar-powered streetlights is that solar energy is available in only the daytime and the need for streetlights is at night. The current solar streetlights rely on batteries which have a short life span and high replacement cost. On the contrary, wind energy is available during the day and nighttime. The average wind speed over the year at Khairpur Mir's is more than 3.8 m/s. Savonius wind turbine is a drag-based vertical axis wind turbine, which can be operated at a low wind speed of around 2 m/s. Helical Savonius is an efficient type compared to its conventional design. Therefore, a Helical Savonius was designed and fabricated at a 45° bend angle. Experimental analysis was conducted in an open-flow wind tunnel to determine the coefficient of performance and starting characteristics. Cost analysis was also carried out for the feasibility assessment of Helical Savonis for powering the streetlights in the Khairpur Mir's. Results revealed the coefficient of performance of 0.15 at the wind speed of 6 m/s, whereas, the cut-in speed of 2.5 m/s was found when operated without a generator. The helical Savonius due to the low cost of energy of only 0.125 $/kWh over the lifetime is a viable choice to replace the solar streetlights.

KEYWORDS: *Coefficient of Performance, Cost of Energy, Helical Savonius, Stating Characteristics, Street Light, Vertical Axis Wind Turbine*

ICEWS #117

ADVANCED SUPERCAPACITOR ELECTRODES: INTEGRATING SPINEL FERRITE (ZNAL0.2FE1.8O4) AND GRAPHENE NANOCOMPOSITES

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ABSTRACT:

Supercapacitors are gaining immense attention as next-generation energy storage devices due to their exceptional power density, rapid charge-discharge rates, and long cycle life. In this study, we focus on the development of supercapacitor electrodes using spinel ferrite ($ZnAl_{0.2}Fe_{1.8}O_4$) and graphene nanocomposites, aiming to enhance their structural and electrochemical properties. Three different compositions were synthesized: pure spinel ferrite (undoped), spinel ferrite doped with 2% graphene, and spinel ferrite doped with 5% graphene. The synthesis process involved the formation of spinel ferrite via a chemical route, followed by the incorporation of graphene to improve conductivity and surface area. The structural characterization was performed using X-ray diffraction (XRD), which confirmed the successful formation of the spinel ferrite phase. A slight broadening and shifting of peaks were observed with graphene doping, indicating strong interactions between the graphene network and ferrite matrix. Morphological analysis using Fourier transform infrared spectroscopy (FTIR) revealed characteristic absorption bands at 533-537 cm^{-1} and 411-413 cm^{-1}, corresponding to the intrinsic stretching vibrations of tetrahedral and octahedral sites, respectively. The observed shifts in band positions suggest modifications in the morphology of synthesized nanoparticles due to graphene incorporation. The experiment aims to explore the impact of graphene doping on the structural and dielectric properties of spinel ferrite-based nanocomposites.

KEYWORDS: Supercapacitors, Spinel Ferrite, Graphene Nanocomposites, Energy Storage,

Supercapacitors, Spinel Ferrite, Graphene Nanocomposites, Energy Storage

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